FINAL

REVIEW AND EVALUATION

OF THE REGULATION AND EFFECTS OF OIL AND GAS DEVELOPMENT ON MULE DEER, SAGE GROUSE, & RAPTORS

On The

Big Piney - LaBarge Winter Range

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SECTION A

REVIEW AND EVALUATION
OF THE REGULATION AND EFFECTS
OF OIL AND GAS DEVELOPMENT ON MULE DEER

On The

Big Piney - LaBarge Winter Range

PART 1. STIPULATIONS ON MULE DEER CRUCIAL WINTER RANGE

USDI-BLM Stipulations

In 1986, US Department of Interior-Bureau of Land Management (USDI-BLM) developed a standard set of stipulations to be applied to oil and gas leases on Wyoming lands under their jurisdiction. The state-wide set of stipulations was developed to achieve consistency in the application of requirements to avoid and mitigate for environmental impacts and other resource and land use conflicts (USDI-BLM 1989). As measures to minimize adverse impacts to resources and other land uses, minimum stipulations applied nationally to leases for drilling, mining, and extraction of leased resources are considered "consistent with lease rights granted provided that they do not" include the following (43 CFR Chapter II, Section 3101.1-2 10-1-89 Edition):

1. Require relocation of proposed operations by more than 200 meters;
2. Require that operations be sited off the leasehold; or
3. Prohibit new surface disturbing operations for a period in excess of 60 days in any lease year.

Stipulations become part of the lease (43 CFR Chapter II, Section 3101.1-3) but can be modified if the protection afforded by the stipulation is not justified or if operations are not expected to cause unacceptable impacts. If necessary, a 30-day period to allow public review of the modification can be required if the issue is a major public concern and/or modifications of lease terms or stipulations are substantial (43 CFR Chapter II, Section 3101.1-4).

Stipulations serve to designate special environmental conditions and requirements that may modify development and operations on portions of the lease (USDI-BLM 1987). With respect to wildlife in Wyoming, standardized stipulations include the following (USDI-BLM 1987, 1989):

1. Protection of important big game winter habitat from November 15 to April 30 from drilling and other surface disturbances. The same limitations can be applied from May 1 to June 30 in areas where elk calving occurs.
2. No drilling and other surface disturbances are allowed from February 1 to July 31 within areas that are designated as nesting habitat for raptors, sage grouse, and/or sharp-tailed grouse.

3. Restrictions on activities or surface use can be applied to a specified area (with legal description) to protect specific habitat (sage grouse or sharp-tailed grouse leks and/or other species during their annual cycle).

4. The presence of threatened/endangered species that are documented by inventories that follow USDI-BLM and US Fish and Wildlife Service guidelines will require modification of operational plans to protect the species and their habitats. Seasonal use restrictions, occupancy restrictions, and facility design modifications can be required.

Crucial Wildlife Range

Potentially, stipulations can apply to big game species which include elk, moose, deer, antelope, and bighorn sheep when they occupy their respective crucial winter ranges from November 15 to April 30 (USDI-BLM 1987, 1989). Recently, the Wyoming Chapter of the Wildlife Society (TWS) proposed that "crucial range" can describe (TWS 1990, page 3):

> "any particular seasonal range or habitat component (often winter or winter/yearlong range in Wyoming) but describes that component which has been documented as the determining factor in a population's ability to maintain itself at a certain level (theoretically at or above the population objective) over the long term."

Documentation of crucial range and other seasonally used ranges depends on recorded observations of animals and/or other indications of animal use (vegetation use, feces, tracks, forage type, forage availability, forage distribution relative to cover). TWS (1990) recognized that variation exists between populations in terms of habitat type and condition, population structure, habituation to existing disturbance, climate, land ownership, and inherent differences between species. Because of these variations, no single set of criteria can be used to designate seasonal ranges statewide (TWS 1990) and final seasonal range designations must follow cooperative efforts and concurrence of all agencies having responsibility for managing some aspect of the wildlife population (TWS 1990).

Summary

The potential effects of USDI-BLM stipulations relevant to oil and gas development and mule deer include:

1. Prohibition of surface disturbances in mule deer crucial winter range from November 15 to April 30. The stipulation does not apply to long-term maintenance and operation of producing wells.

2. Stipulations, once specified in the lease agreement, can be modified depending on environmental condition.

3. Criteria used to define crucial mule deer winter range will depend on available information. Crucial range can be the determining factor in a population's ability to maintain itself at some desired level.

PART 2. COORDINATED ACTIVITY PLAN

Mule Deer Winter Range Management Objectives

The Big Piney - LaBarge area west of Highway 189 coincides with a mule deer winter range that overlaps with areas of intense oil and gas developments and livestock grazing (USDI-BLM 1987). A coordinated activity plan (CAP) was prepared by USDI-BLM to integrate resource and land use management with oil and gas developments (USDI-BLM 1990a). Specific objectives for wildlife management in the CAP include the following (USDI-BLM 1990a, pages 3-4):

1. Provide sufficient quantity and quality of winter and transitional habitat to overwinter a healthy mule deer population (as determined by the Pinedale RMP).

2. Maintain or improve delineated crucial winter range in the CAP area as an essential component to the Wyoming Range mule deer population.

3. Mitigate habitat losses associated with the development of energy resources.

4. Protect sage grouse breeding and nesting habitat.

5. Protect raptor nesting habitat.

6. Enhance pronghorn habitat.

7. Maintain, enhance, or restore riparian habitat and associated fish-bearing streams.

8. Protect threatened and endangered species habitat.

To achieve these wildlife objectives, mitigation guidelines have been specified in the CAP which set constraints on certain activities and conditions for approval of proposed activities. These include the following (USDI-BLM 1990a, pages 7-8) which reflect USDI-BLM state-wide wildlife stipulations on oil and gas developments:

1. No activities or surface use will be allowed from November 15 to April 30 within big game winter range to protect important big game winter habitat.

2. No activities or surface use will be allowed from February 1 to July 31 within certain areas to protect important raptor and/or sage grouse nesting habitat. The same restriction can apply to defined raptor and game bird winter concentration areas from November 15 to April 30.

3. No activities or surface use will be allowed on areas identified as having unique wildlife habitat or unique wildlife values (areas which cannot be protected with seasonal restrictions). Examples include sage grouse leks and raptor nests. Generally, a 1/4 mile buffer may be required, but distances may vary depending on the nature of the project and sensitivity of the habitat.

4. Prior to conducting any surface-disturbing activities on an area known or suspected to be essential habitat for threatened or endangered species, the lessee/permittee will be required to conduct inventories or studies in accordance with BLM and U.S. Fish and Wildlife Service guidelines to verify the presence or absence of this species. In the event a threatened or endangered species is identified, the lessee/permittee will be required to modify operations to comply with protection requirements for the species and its habitat.

5. Wildlife escape devices will be installed and maintained in all water troughs.

Similar to the application of state-wide stipulations, modifications of any limitation may occur in any year if approved in writing by authorized USDI-BLM officials.

Habitat Management

Management of wildlife populations (except for federally listed threatened and endangered species, migratory wildlife designated by international treaty, and other species named in federal legislation that are under jurisdiction of the US Fish and Wildlife Service) is the responsibility of the Wyoming Game and Fish Department. Consequently, actions planned by USDI-BLM to affect wildlife within the CAP area focus on treatments of vegetative components of wildlife habitat and cooperative planning with WGFD and land users (eg. the oil and gas industry). Specific planned vegetation treatments outlined in the CAP include the following (USDI-BLM 1990a, page 10):

1. Manipulation of specific acreages of sagebrush-grassland and sagebrush-salt desert shrub types by specified techniques on public lands within crucial winter range to be achieved by specified times.

2. Conduct similar manipulations of sagebrush-grassland on public lands within transitional and winter-yearlong range to be achieved by specified times.

3. Manipulate desert shrubs to stimulate and rejuvenate Gardner's saltbush and winterfat, as well as sagebrush.

4. Implement treatments to rejuvenate and perpetuate, or stimulate and expand the mountain shrub components in specified acreages of sagebrush-mountain shrub associations within the CAP.

5. Rejuvenate selected stands of seral aspen in transitional and winter-yearlong range. Inventory and prioritize treatments for all aspen associations.

In addition to vegetation treatment, the CAP specifies that energy development-related habitat losses be mitigated by the following (USDI-BLM 1990a, page 11):

1. Integration of specified shrub plantings into current reclamation practices.

2. Continued use of seasonal protective conditions of approval for development activities on crucial winter ranges.

3. Avoidance of mountain shrub communities in road and well pad construction.

Since livestock grazing in the North LaBarge Common allotment includes much of the crucial mule deer winter range within the CAP area, an intensified grazing management planned action is called for in the CAP (USDI-BLM 1990a, pages 10-13). The objective for wildlife of intensive livestock grazing management is to accommodate the physiological needs of important deer forage. Presumably, wildlife will benefit if improved livestock grazing practices are implemented (USDI-BLM 1990a, pages 11-13):

1. Subdivide the allotment into smaller pastures to receive differentially intensive deferred grazing systems. Livestock will be removed from a pasture when 50% utilization of the current year's growth on key species is reached.

2. Improvement and increases in livestock forage will be attained through creation of new water sources, drift fences to control livestock distributions, deferred grazing system, sagebrush manipulations to create more grass and rejuvenate decadent sagebrush, recovery of livestock forage losses on areas affected by energy resource development, improved livestock distribution, improvements for forage production, water availability and soil stabilization in riparian areas.

3. Establish accurate stocking rates and forage allocation through livestock and vegetation monitoring.

<u>Oil and Gas Developments</u>

USDI-BLM anticipates additional oil and gas developments with concomitant acreage committed to well pads and ancillary facilities. Other wells will be abandoned which will allow for vegetation restoration. Since the early 1900's a total of 4,800 acres of crucial winter and transitional range has been developed and rehabilitated, according to applicable guidelines and requirements, by oil and gas operations. A total of 3,200 acres are currently committed to producing oil and gas wells and related facilities (USDI-BLM 1990a, page 22), and will, following productive life, be rehabilitated according to current

guidelines and requirements. To mitigate against habitat losses, particularly within crucial winter and transitional ranges of mule deer (the primary wildlife habitat of concern in the CAP project area) for which no plan currently exists, four measures are specified in the CAP. These include (USDI-BLM 1990a, pages 22-24):

1. Seasonal restrictions to avoid conflict with deer during the winter,

2. Reclamation seeding of shrub forage species preferred by mule deer during the winter as opposed to seed mixes of grass species having limited forage value,

3. Protection of mountain shrub communities which, because of their occurrence on steep slopes and aspect orientation, are a critical component of the winter range,

4. Seasonal closure of roads which have little value to maintenance of oil and gas operations.

Consistent with 43 CFR Chapter II Section 3101.1-4 (10-1-89 Edition), applications for exceptions to seasonal restrictions are possible after review of the following information necessary to support such a decision (USDI-BLM 1990a, page 23):

1. Type of operation and associated disturbance factors (noise, traffic, equipment, length of time required).

2. Wildlife density, distribution, and condition.

3. Habitat condition (forage availability).

4. Location of the project (relating to possible wildlife habituation to the activity).

5. Current climatic factors (temperature and snow).

6. Weather forecast for the duration of the project.

7. Time of year (i.e., early, mid, or late winter).

8. Opportunity for mitigation.

According to USDI-BLM records from the Pinedale Resource Area office, 95% of the requests for exceptions to seasonal restrictions (21 of 22 requests) have been granted for well drilling within the CAP area since December 1988 when the Pinedale Resource Management Plan became effective. Most exceptions were granted for the periods of early winter (November 15 to December 15) or early spring (March 30 to April 30) (USDI-BLM 1990b), presumably due to the occurrence of mild winters in the RMP Area.

Summary

Specific mitigation of oil and gas developments prescribed by the BLM that are pertinent to mule deer include:

1. Prohibition of surface activities on important big game range from November 15 to April 30. Exceptions to temporal restrictions have been made in the past and have been justified by local environmental conditions.

2. Avoidance of key mule deer habitat (mountain shrub vegetation).

3. Winter closure of roads having little value to oil and gas operations.

4. Mitigation of energy-related habitat loss is to include integration of shrubs into reclamation practices.

PART 3. WYOMING RANGE MULE DEER HERD UNIT

Mule Deer Population

The Big Piney - LaBarge mule deer winter range is within the Wyoming Range Mule Deer Herd Unit. The most expansive mule deer herd unit in Wyoming, it extends north from the Snake River to Interstate 80 in the south and from Wyoming's borders with Idaho and Utah on the west to the Green River on the eastern boundary. The current (1990) post-harvest population objective for this herd unit is 38,000 mule deer (WGFD 1990).

However, POP-2 population modeling of the deer herd has estimated a post-season (after harvest) population estimate of 55,908 deer, well in excess of the objective. Because winters since 1983-1984 have been mild, the deer population has increased from an estimated 16,643 animals at the end of that severe winter. Prior to winter 1983-1984, the previous severe winter occurred during 1978-1979. During the interim periods of mild to normal winter conditions, the mule deer population grew to a maximum estimated post-season population of 40,152 deer in 1981. Since mule deer harvest has ranged from 1,478 animals in 1984 to 3,918 harvested in 1988, it appears that winter climatic conditions have a profound influence on this population's growth, well beyond the effects of hunting.
The current WGFD management goal is to decrease this population to its objective level of 38,000 by 1994. To attain their goal, they plan more extensive harvest of deer over the next five years: a minimum of 4,000 antlerless (does and fawns) and 4,700 antlered deer each year. WGFD estimates the 1990 harvest will total 9,519 deer by resident and non-resident hunters (WGFD 1990).

Available data on post-harvest sex and age classification reveal that as the mule deer population has increased since the severe winter of 1983-1984, so too has the production of young which has increased from 70 fawns:100 does in 1984 to 90 fawns:100 does in 1988 (Lockman 1989). The increased reproductive rate of deer in the population has been attributed to mild winter conditions since winter 1983-1984 that have favored fawn survival. Likewise, the proportion of yearling and adult males has increased in the population from 23 bucks:100 does in 1984 to 52 bucks:100 does in 1988 due to increased winter survival of males. Based on the high correlations of field data with modeled population sex and age compositions, WGFD believes the POP-2 model used to simulate the Wyoming Range deer population is realistic (Lockman 1989).

Big Piney - LaBarge Winter Range

Although there are several distinct winter ranges within the Wyoming Range herd unit, the Big Piney-LaBarge winter range is used by the largest proportion of wintering deer in the population (an estimated 35%) though it is third in area (215,723 acres) to the southern Slate Creek-Fontenelle Creek winter range (252,047 acres) and Cokeville-Rock Creek

winter range (217,452 acres) (Edberg 1990). During winter 1989-1990, an estimated 20,000 deer used the Big Piney-LaBarge range (Edberg 1990).

Mule deer distributions on the Big Piney-LaBarge winter range have been intensively surveyed by WGFD since winter 1986-1987 as part of a study of mule deer winter mortality (Edberg 1990). Prior to 1986, mule deer have been observed and recorded on the Big Piney-LaBarge winter range at least since winter 1978-1979. Recently, Cundy (1989) summarized all winter observations of mule deer on map overlays for the winter range. Data has been segregated by year, compiled for winters with similar severity conditions (mild to normal, severe), and by winter time periods (November 15 - December 15; December 16 - January 20; January 21 - February 28; and March 1 - April 30). This information may be used, if necessary, to revise seasonal ranges used by deer on the Big Piney - Labarge winter range (Bob McCarty, USDI-BLM Pinedale Resource Area, personal communication with A. Reeve, HWA).

Mule Deer Habitat Evaluation

Habitat within the Big Piney - LaBarge winter range has been evaluated recently (Cundy 1989). Over 60% of the 86,590 acres of shrub vegetation studied within defined crucial mule deer winter range was found to be in fair to poor condition and judged as incapable of perpetuation. Although sagebrush in those shrub communities had received an average 45% utilization, other shrub species (mountain mahogany, Gardner's saltbush, winterfat) had been utilized more than sagebrush (Cundy 1990). Analyses of mule deer fecal pellets revealed a large proportion of shrubs, particularly sagebrush, in deer diets from December through April with forbs and grasses utilized more during March and April than during the previous three months of winter (Cundy 1990).

Unfortunately, no comparable evaluation of mule winter habitats has been conducted on other winter ranges within the Wyoming Range herd unit. Such data could be used to determine if habitat conditions on the Big Piney - LaBarge winter range are unique within the herd unit. However, an earlier study of browse plants on winter ranges now identified as the Cokeville-Rock Creek range, Slate Creek-Fontenelle Creek range, and the vicinity of LaBarge reveals overuse of species including true mountain mahogany, antelope bitterbrush, serviceberry, curlleaf mountain mahogany, and rabbitbrush. Use of these species was estimated at 65-70%, in excess of 40-55% use considered proper on deer winter ranges (Anderson and Wilbert 1958).

Mule Deer Response to Disturbances

In December 1988, five adult mule deer does were captured on the Big Piney - LaBarge winter range and outfitted with radio telemetry collars. In January 1990, telemetry signals indicated that the deer had returned to the winter range in the vicinity of where they were captured (Smith 1990). Three of the deer were intensively observed between January

20 and March 20, 1990 to determine activity budgets and their responses to disturbances which were limited to vehicles on existing roads.

From these observations it appeared that the deer spent more time feeding when ambient temperatures were below freezing than when temperatures exceeded 32 oF. When vehicles passed by deer, their overt responses were slight or undetectable. Deer that were feeding tended to continue feeding or watch the vehicle as it passed, then resumed feeding. Deer that were bedded stood when a vehicle approached then began feeding when the vehicle had passed.

Observations of mule deer on the Big Piney-LaBarge winter range have been made by Mr. Glenn Thomas of Marbleton. His observations concur with results of the WGFD study: mule deer do not respond vigorously to traffic or existing oil and gas activities. However, he has not observed the response of mule deer to oil and gas developments where none previously existed. However, a USDI-BLM biologist observed mule deer vacating the area surrounding a well site as drilling was taking place during late winter (Bob McCarty, USDI-BLM Pinedale, personal communications with A. Reeve, HWA). After drilling began, though, mule deer were seen by rig operators to be in the vicinity of the drill site (Andrew Morris, Enron Oil Company, personal communication with L.D. Hayden-Wing, HWA).

Summary

1. The Wyoming Range mule deer population has exceeded desired objective levels and appears to be increasing.

2. Distributions of mule deer on winter range have been used to designate crucial winter range.

3. Vegetation used by mule deer on the Big Piney-LaBarge winter range is in fair to poor condition.

4. The limited direct observations and data available indicate that mule deer in the vicinity of oil and gas developments on the Big Piney - LaBarge winter range appear to have habituated to those activities and to traffic.

PART 4. WINTER MORTALITY OF MULE DEER

Winter Mortality Study

In December, 1986, WGFD began a study of mule deer winter mortality on four winter ranges within the Wyoming Range Herd Unit. The winter ranges are the Big Piney-LaBarge range (BP-La), Slate Creek-Fontenelle Creek range (SC-FC), Cokeville-Rock Creek range (C-RC), and Star Valley Front range (SVF). The study is scheduled to continue through winter 1990-1991.

During December, February, and April mule deer on each winter range have been surveyed from the ground to determine numbers of fawns and adults as well as habitat characteristics associated with each observation. In some years, aerial surveys were conducted during December and April to provide comparative data. During the first year of the study, data was consistently collected only on the BP-La range from the ground.

Analysis of Data

The change in proportion of fawns observed during April (end of winter) from the proportion of fawns observed during December (beginning of winter) can be used to detect fawn mortality relative to adult mortality during the winter (Reeve and Lindzey in prep.). Procedures exist to compute the actual fawn mortality rate (MRf) with the data collected in the Wyoming Range mule deer mortality study. But, estimates of the adult mortality rate (MRa) are necessary to use the following formula:

$$MRf = Dp + [MRf\ (Pfp - Pfp\ Dp)] + [MRa\ (Pap - Pap\ Dp)] \qquad (1)$$

where

Pfp = proportion of fawns in the population during post-season (December),

Pap = proportion of adults in the population during post-season.

Similarly,

Pfe = proportion of fawns in the population at the end of winter (April),

Pae = proportion of adults in the population at the end of winter,

and

Dp = proportional decrease in the proportion of fawns in the population from post-season (December) to the end of winter (April) so that

$$Dp = \frac{Pfp - Pfe}{Pfp} .$$

Unless data such as mortality counts or mortality of tagged animals are available, MRa is unknown. But, by setting MRa = 0, solution of equation 1 will yield a minimum fawn mortality rate, MRf(min),

$$MRf(min) = Dp + MRf(min)\,(Pfp - Pfp\,Dp) \qquad (2)$$

In equations 1 and 2, MRf or MRf(min) is computed by iteration. Comparing the two equations, it is obviously that the actual MRf will exceed MRf(min) if there is some level of adult mortality (MRa > 0).

Analyses of data collected on each winter range since winter 1986-1987 are presented in Table 1. Data collected during winter 1987-1988 indicate that MRf(min) for deer on each of the 4 winter ranges is negative; the proportion of fawns in the population increased during the winter. This is only possible if adult mortality greatly exceeded fawn mortality so that more fawns relative to adults were observed in April than in December. Since that is unlikely, it appears that the 1987-1988 data are biased in some way. According to Edberg (1989), the apparent increase in the proportion of fawns on all four winter ranges during April, 1988 surveys was a possible result of the following: 1) solitary adults migrating from the winter range earlier than adults with fawns during mild winters, 2) similar mortality of fawns and adults during mild winters, 3) misclassification of fawns and adults, particularly during that mild winter, and/or 4) inadequate sample sizes during December, 1987 and/or April, 1988 surveys. Therefore, the data collected in 1987-1988 are omitted from additional analysis.

The analyses show that in winter 1988-1989, the MRf(min) of fawns on the BP-La winter range was 35.67%, nearly as large as the MRf(min) detected on the SVF winter range and greater than on the other two winter ranges. At the end of winter 1989-1990, the MRf(min) of fawns on the BP-La winter range was 15.39%, again second only to MRf(min) of fawns on the SVF winter range (21.97%). At the end of winter 1986-1987, a MRf(min) of 19.22% was computed for deer on Bp-La winter range although no comparable information was collect on the other three winter ranges. Probably some adult mortality occurred on the different winter ranges during each winter so that MRa > 0. Consequently, the actual fawn mortality rates would exceed the MRf(min) values shown in Table 1.

Winter Severity

Reeve and Lindzey (in prep.) developed a winter index (WI) to evaluate winter severity conditions based on levels of precipitation and temperature during the winter period (November through March):

$$WI = (Ppt / MMdt) \times 100 \quad (3)$$

where,

Ppt = total precipitation (inches of water) during winter, and

MMdt = mean maximum daily temperature (degrees F) during the same period.

Severe winters have larger WI values (cold and wet) than mild winters (warm and dry). The necessary data have been collected by National Weather Service (NWS) cooperators. There is at least one NWS station within or proximate to each winter range. Values for Ppt and MMdt were averaged for the different NWS stations to compute the Winter Index for each winter range during each winter since 1986-1987. The climatologic values for each month at each station are in Appendix A. The average values and computed WI are provided in Table 2. For each of the winters analyzed, WI values were largest on the SVF winter range and least on the BP-La range (Table 2). Winter severity conditions were similar in most years on the SC-FC and C-RC winter ranges. In general, it appears that winter conditions are most favorable for mule deer survival on the winter ranges east of the Wyoming Range, particularly on the Big Piney-LaBarge winter range.

Interpretation of Analyses

In Figure 1, minimum fawn mortality rates, MRf(min), for deer on each winter range are plotted against the winter index, WI, for that range. Except for the BP-La range, only 2 years of analysis are possible and therefore trends are only tentative. However, MRf(min) on each winter range except on the BP-La range appear to be a direct function of winter severity: as WI increases so does the MRf(min). This is not the case for MRf(min) on the BP-La winter range on which mule deer fawn mortality is higher than would be expected by the mild winter conditions recorded at the Big Piney and LaBarge NWS stations. Further, MRf(min) on the BP-La winter range fluctuated between 1986-1987 (19.22%), 1988-1989 (35.67%), and 1989-1990 (15.39%) even though WI values during those three winters were very similar: 4.61, 5.76, and 5.80, respectively. The winter index, however, may not adequately account for all the climatological factors that can affect mule deer winter mortality on every winter range.

Other sources of impacts to mule deer are known to occur within the Wyoming Range Herd Unit. The elevated minimum fawn mortality rates on the C-RC winter range are

possibly due to winter mortality of deer due to collisions with vehicles on US Highway 30 and the Union Pacific Railroad through Nugget Canyon (Reeve 1990). During four winters, 1986-87 through 1989-90, vehicles and trains have killed at least 1,126 mule deer, an average of 282 deer killed per winter (Reeve 1990). The most deer killed during a single winter were 381 in 1988-1989. WGFD estimated the Wyoming Range mule deer population at the beginning of winter 1988-1989 to be 55,908 animals (Lockman 1989). Edberg (1990) estimated that 30% of the Wyoming Range mule deer population uses the C-RC winter range; at the start of winter 1988-1989 an estimate of 1677 deer were on the C-RC winter range. The 381 deer killed by vehicles in Nugget Canyon were approximately 2.3% of the total deer on that winter range. Similar calculations produce similar estimates of deer killed during the first two years of the study: 1.9% killed in winter 1986-1987 and 2.3% killed in 1987-1988.

The results showing comparative minimum fawn mortality rates on the four winter ranges studied indicate that winter weather conditions on the BP-La winter range are not the only cause of fawn mortality during winter. Although data showing cause-and-effect relationships are not available, other factors affecting fawn mortality may include the following: 1) poor forage condition resulting from over-utilization and/or drought conditions, (Anderson et al. 1972, deCalesta et al. 1975, Anthony 1976) 2) intra-specific competition wherein adult deer out-compete fawns for available high-quality forage that may result in density-dependent mortality, especially during severe winters (Gilbert et al. 1970, White et al. 1987), 3) inter-specific competition of other native ungulates and livestock (McKean and Bartmann 1971) occupying the winter range with mule deer fawns. Additionally, there is more human activity, primarily oil and gas development, on the BP-La winter range than on the other three ranges with concomitant loss of habitat due to surface disturbances. Unfortunately, there have been no evaluations of forage condition on the SC-FC, C-RC, and SVF winter ranges comparable to the study done on the BP-La winter range by Cundy (1989). Because of this and the lack of information on all other environmental factors that can affect overwinter mortality of deer, the contributing effects of oil and gas activity, forage, and competition can not be discerned from the data and analyses presented here.

Summary

1. Since winter 1986-1987, winter conditions have been less severe on the Big Piney-LaBarge than on other winter ranges in the Wyoming Range Mule Deer Herd Unit.

2. Minimum fawn mortality on the Big Piney-LaBarge winter range exceeds that on most other winter ranges and is greater than expected on the basis of winter severity conditions.

3. There are probably factors other than winter conditions that have caused increased mortality on the Big Piney-LaBarge winter range. Habitat condition, competition, and surface disturbances may be contributing factors but data are insufficient to determine the extent of each.

4. Levels of oil and gas drilling activities do not appear to be related to fluctuations in minimum fawn mortality rates on the Big Piney - LaBarge winter range during the winters of 1986 through 1990. The numbers of wells drilled during these winters (December - April) remained consistently low (85-86 = 2 wells, 86-87 = 0 wells, 87-88 = 1 well, and 88-89 = 2 wells) (USDI-BLM 1990b), while minimum fawn mortality rates varied from 15.4% to 35.7%.

TABLE 1. Composition data and values used to compute minimum fawn mortality rates on each winter range studied since the Wyoming Range Mule Deer Mortality Study began in winter 1986-1987. Only ground survey data are included. The terms Pfp, Pfe, Dp, and MRf(min) are defined in the text.

Winter Range	Winter	December Survey Data				April Survey Data					
		Fawns	Adults	Total	Pfp	Fawns	Adults	Total	Pfe	Dp	MRf(min)
BP-La	86-87	555	882	1437	0.39	369	726	1095	0.34	0.13	19.22%
	87-88	465	763	1228	0.38	567	909	1476	0.38	-0.01	-0.88%
	88-89	464	777	1241	0.37	1033	2689	3722	0.27	0.26	35.67%
	89-90	1059	1606	2665	0.40	901	1615	2516	0.36	0.10	15.39%
SC-FC	86-87		not surveyed			47	77	124	0.38	-	-
	87-88	231	410	641	0.36	185	296	481	0.38	-0.07	-10.93%
	88-89	198	393	591	0.34	143	342	485	0.29	0.12	17.01%
	89-90	337	664	1001	0.34	187	405	592	0.32	0.06	9.03%
C-RC	86-87		not surveyed			66	105	171	0.39	-	-
	87-88	358	572	930	0.38	364	561	925	0.39	-0.02	-3.67%
	88-89	465	718	1183	0.39	418	963	1381	0.30	0.23	32.98%
	89-90	357	648	1005	0.36	589	1223	1812	0.33	0.08	12.58%
SVF	86-87		not surveyed				not surveyed			-	-
	87-88	20	32	52	0.38	86	106	192	0.45	-0.16	-29.81%
	88-89	190	320	510	0.37	46	128	174	0.26	0.29	39.47%
	89-90	88	132	220	0.40	90	173	263	0.34	0.14	21.97%

TABLE 2. Summary of average conditions of mean maximum daily temperatures (MMdt, degrees F) and total precipitation (Ppt, inches of water), and Winter Index (WI) for four winter ranges included in the Wyoming Range Mule Deer Winter Mortality Study. NWS data is provided in APPENDIX A.

Winter	1986-1987			1987-1988			1988-1989			1989-1990		
Range	MMdt	Ppt	WI	MMdt	Ppt	WI	MMdt	Ppt	WI	MMdt	Ppt	WI
BP-La	36.9	1.70	4.61	37.7	1.67	4.43	34.9	2.01	5.76	38.3	2.22	5.80
SC-FC	35.8	3.19	8.92	35.6	2.65	7.44	33.8	4.12	12.17	37.8	3.34	8.84
C-RC	35.4	2.84	8.03	31.4	4.14	13.18	31.0	4.18	13.47	35.3	3.01	8.53
SVF	36.8	3.59	9.76	34.4	5.06	14.71	32.6	8.83	27.09	34.3	5.20	15.16

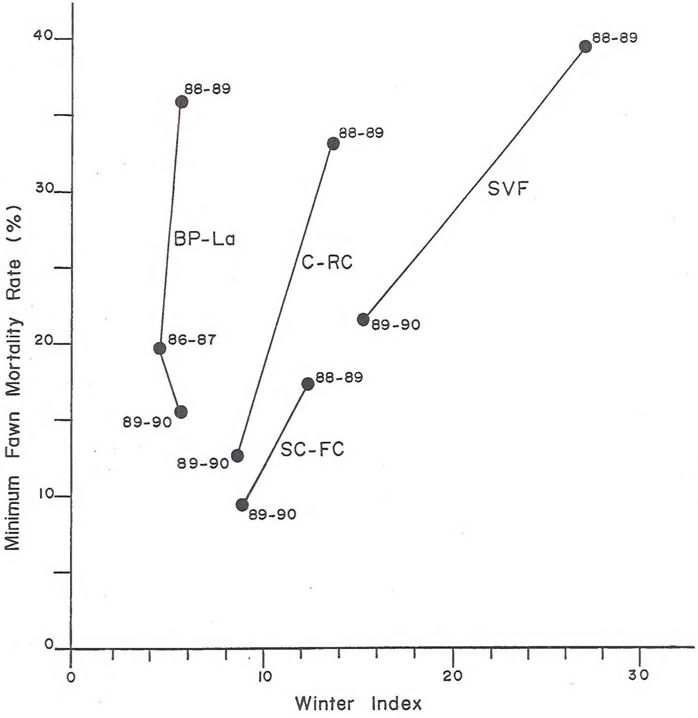

FIGURE 1. Relationship of minimum fawn mortality rates, MRf(min), to winter index levels on 4 winter ranges: Big Piney-LaBarge (BP-La), Slate Creek-Fontenelle Creek (SC-FC), Cokeville-Rock Creek (C-RC), and Star Valley Front (SVF). Data points for each winter are labeled.

PART 5. MULE DEER RESPONSE TO HUMAN ACTIVITIES

A bibliographic database search was performed by the Science and Technology Library at the University of Wyoming, Laramie, for listings of all published scientific literature related to the effects of oil and gas developments on mule deer. Additional literature about mule deer response to hunting, roads, vehicles, logging, mining, and other disturbances by humans was also requested in the search.

Impacts to mule deer would be considered significant if there was any adverse change in a population's birth rate, growth, and/or survival of individuals (Anderson 1985) as a result of oil and gas developments. Primary or direct impacts are those direct actions associated with some phase of development that would directly decrease levels of wildlife populations (Comer 1984). But indirect impacts to mule deer can occur through habitat alterations associated with project activities, whether through destruction, habitat subdivisions, structural changes or rendering habitats unavailable (Anderson 1985). If these changes to wildlife habitat take place, there may be consequences to a population's birth rate, growth, and/or survival of individuals, as above. Generally, however, studies of relationships between oil and gas development and wildlife have not demonstrated changes in wildlife population levels as direct or indirect results of petroleum industry activities (PRISM 1982).

Effects of Oil and Gas Development

No literature specifically addressing the response of mule deer to oil and gas development was listed in any of the databases searched. However, two unpublished reports of such studies are available, one conducted in Wyoming (Hiatt and Baker 1981) and the other in Montana (Ihsle 1982). In addition, Gusey (1986) interviewed wildlife managers in 13 states for their evaluations of the effects of the oil and gas industry on mule deer and other wildlife. Currently, a study of pronghorn and mule deer responses to petroleum industry activities is being conducted in central Wyoming but reports are not yet available (Richard Guenzel, Wyoming Game and Fish Department, Casper, personal communication with A. Reeve, HWA).

In Wyoming, Hiatt and Baker (1981) used track counts, time-lapse cameras, aerial and ground observations of mule deer and elk to determine animals' responses to a wildcat well drilled on winter range in central Wyoming. Unfortunately, pre-development observations were possible for only eight days (mid-February), limiting the baseline data used for comparisons during road construction and maintenance (late February through late April), and drilling the well (mid-March through late May). Oil well fields had been developed, although some had been abandoned, in the vicinity of the wildcat well at the time of the study.

Compared to track counts and mule deer sightings during mid- to late February before installation of the drill rig, mule deer observations made during installation in mid-March indicated that deer shifted 1.6 km away from the well site. This interpretation was based on temporal comparisons of deer track counts in shrub-pine habitats. Observations of deer in shrub vegetation, only, did not indicate that deer had shifted away from the well site. And, the distribution of deer tracks near the well access road during drilling did not change significantly from the distribution of tracks before development.
The results of this study were not conclusive for several reasons: 1) the short period of baseline data, 2) poor conditions for counting tracks in March and April, after drilling began, and 3) there was no control area where drilling or other activities were absent for comparative levels of variation in deer distributions within the same time period, mid-February through May. By not having a control area and deer population in the study, it was impossible to determine whether changes in deer distributions relative to the well were due to development activities, due to deer responses to phenological changes in vegetation, snow cover characteristics, or all of these factors.

In Montana, Ihsle (1982) monitored radio-collared and neck-banded mule deer on winter ranges in consecutive years. In this study, telemetered deer in the vicinity of oil developments shifted their centers of winter activity from 1.8 to 4.1 km away from the developments from one year to the next. Deer that inhabited a winter range where no drilling activity occurred similarly shifted their activity centers during the same two years of the study. Ihsle (1982) concluded that movements of deer were more likely due to differences in winter conditions than to the presence of oil development activities. Indeed, summer observations of deer that were 3 km from seismic lines indicated they had only mild behavioral responses (looking up, running for short distances then feeding) to seismic blasts (Ihsle 1982). It was concluded that oil and gas activities in the study area had no measurable effect on mule deer distribution, population levels, or production of young (Ihsle Pac et al. 1988).

After interviewing wildlife managers in Texas, Oklahoma, North Dakota,and New Mexico, Gusey (1986) concluded that mule deer will initially abandon areas influenced by oil-related activities, but would eventually habituate to developments associated with the petroleum industry. Sources of disturbances discussed during interviews included seismic activity, roads, drill pads, pipelines, support facilities, and others. Gusey (1986) concluded, that local mule deer populations were significantly impacted by illegal hunting as an indirect result of increased access during petroleum developments. Similar indirect impacts to mule deer were observed in proximity to phosphate mines in southeast Idaho (Kuck and Ackerman 1984).

<u>Effects of Surface Coal Mining</u>

In Montana a ten-year study of the effects of surface coal mining on mule deer and other wildlife showed that, in spite of an extensive increase in mining disturbances and activities

over an 863 km2 area, the mule deer herd prospered and increased in numbers from 90 animals in 1977 to over 600 in 1984 (Phillips et al. 1986). The only negative impact reported was an increase in numbers of deer killed due to collisions with motor vehicles and poaching.

Effects of Hunting

Geist (1971) has argued that when humans ignore free-ranging ungulates by not hunting or harassing them, the animals will eventually habituate to human presence and activities. Human activities that present no threat to animals permit habituation and common, localized obnoxious disturbance are easily avoided. Alternatively, disturbances that are frequent but unpredictable in time and space are potentially more obnoxious. Animals have no opportunity to associate disturbances with a particular location and, therefore, cannot adjust to avoid or adapt to the phenomena.

Geist (1971), as well as Cowan (1974), maintained that escape behavior is, in part, a learned consequence of hunting. Escape also includes generalized responses to unusual, threatening environmental stimuli such as predators (Geist 1981). During the hunting season in Montana, mule deer moved to upland timber cover, if it was available, or increased their use of hillsides in treeless areas (Swenson 1982). Desert mule deer moved to refugia when hunting seasons opened (Rodgers et al. 1978). And, several authors (Wilkins 1957, Lovaas 1958, Mackie 1970) noted mule deer used dense vegetation prevalent on north slopes as security cover during hunting seasons.

In Colorado, mule deer did not move out of their established home ranges when hunting season began. But, deer used vegetation types within their home ranges that provided better escape cover more often during the hunting season than prior to hunting (Kufeld et al. 1988). In a study of white-tailed deer, Behrend and Lubeck (1968) found that when they are hunted, antlered deer displayed significantly greater flight distance than deer on a non-hunted site. Furthermore, the response of antlered deer to people on the hunted area was significantly greater than antlerless deer on both areas suggesting that experience related to hunter preference influenced the response by antlered bucks. These behaviors reflect generalized responses to danger, similar to the presence of predators: deer will move to where there are no predators or to where escape cover exists (Geist 1981). It appears that hunting mule deer sensitized them to the effects of other sources of human disturbance.

Effects of Roads and Vehicles

In their review and recommendations for logging in relation to deer and elk habitat, Black et al. (1976) listed maintaining screening cover along roads as one of several means to mitigate the disturbing effects of roads on deer. The recommendation appears to be valid. In a study of the distribution of mule deer fecal pellets in relation to roads in Colorado,

Rost and Bailey (1979) concluded that deer avoided roads more in shrub habitats than in pine and juniper vegetation. Deer avoided unimproved roads used primarily by recreationists as well as graveled roads; avoidance was more pronounced on the east than the west side of the Continental Divide, an effect attributed to more habitat available away from roads on the east than on the west side of the Divide (Rost and Bailey 1979). Whether there was differential hunting pressure on deer in the two areas was not examined, but paved highways apparently did not affect deer fecal pellet distributions.

Similarly, mule deer wintering along Interstate 80 in southern Wyoming showed little concern for traffic (Ward et al. 1980) and the main impact of that thoroughfare was through vehicle collisions with deer (Goodwin and Ward 1976, Ward et al. 1976). Likewise, vehicles on US Highway 30 and trains on Union Pacific Railroad tracks through Nugget Canyon in Lincoln County, Wyoming, have caused substantial mortality of mule deer as they migrate to and from the Cokeville-Rock Creek winter range (Reeve 1990). During 4 winters from 1986-87 through 1989-90, vehicles and trains have killed at least 1,126 deer, an average of 282 deer killed per winter (Reeve 1990). However, the number of deer killed each year is only an estimated 1% to 3% of the total deer utilizing that specific winter range and smaller proportions, still, of the total herd unit population.

Effects of Other Sources of Disturbance

In general, ungulate response to humans outside of vehicles is greater than to moving, or even stationary vehicles (Ward et al. 1973, Ward 1975, Kucera 1976, MacArthur et al. 1979). Tolerance for predictable vehicular traffic has been shown for pronghorns (Reeve 1984), mule deer (Ward et al. 1980), elk (Ward et al. 1973, Ward 1975), and bighorn sheep (MacArthur et al. 1982). An extreme case of tolerance to humans and their associated activities is documented by Crockett and Green (1986) who describe the management problems created by a wild mule deer population which colonized the western edge of the city of Boulder, Colorado and use it as year-round habitat. Major problems include hazards to the safety of humans and deer caused by collisions of deer with motor vehicles, and extensive depredation damage to ornamental shrubs in the lawns of local residents.

Perhaps more remarkable, though, have been studies conducted on the effects of snowmobiles on white-tailed deer (Dorrance et al. 1975, Richens and Lavigne 1978) and on mule deer (Freddy et al. 1986). White-tailed deer in Maine used packed snowmobile trails for travel and apparently were not displaced from the vicinity of trails when used by several snowmobiles a day (Richens and Lavigne 1978). In Minnesota, however, light snowmobile traffic displaced white-tailed deer from areas adjacent to trails but heavy traffic did not cause additional displacement (Dorrance et al. 1975). In contrast, deer in areas where snowmobiles were absent, increased their home-range size, daily movements, and distance from snowmobile trails as snowmobile activity increased (Dorrance et al. 1975).

Similar results were found in a study that compared the response of marked female mule deer in Colorado to snowmobiles and to people walking (Freddy et al. 1986). People afoot elicited escape responses for longer duration and distances with concomitant greater energy expenditure by mule deer than did snowmobiles. When deer were exposed to people on foot two and three times, the distance at which a person caused a deer to escape increased, suggesting that deer became more sensitive to the human disturbance after an initial encounter (Freddy et al. 1986). There were no discernable effects of the controlled disturbance study on mortality or fecundity of study animals.

Very few studies have demonstrated cause-and-effect relationships between environmental disturbances and decreased survival and/or reproduction in free-ranging animals. Recently, a study conducted in Canada provided strong support for decreased fecundity of mule deer as a result of harassment (Yarmoloy et al. 1988). Radio-collared female mule deer were exposed to an all-terrain vehicle (ATV) that, for 12 weeks, travelled by the deer on the same established road. The deer escaped from the ATV significantly less often at the end of the 12-week period than at the beginning, indicating they had habituated to the disturbance. In October, the researchers began harassing 3 deer by pursuing them daily or every other day with the ATV for 9-minute periods.

The harassed female mule deer changed their behavior as a result of harassment: 1) they utilized cover more than before harassment and more than the unharassed deer, 2) unlike the unharassed deer, they shifted their feeding patterns to darkness, feeding mostly before sunrise and after sunset, 3) their flight responses from the ATV were significantly more pronounced than prior to harassment, and 4) they were found outside of their previously established home range more often after harassment began compared to before harassment and compared to unharassed animals. Of particular significance was the finding that the harassed females collectively produced one fawn the spring after they were harassed. But, one year before and one year after the harassment study they collectively produced 4 and 5 fawns during respective years. The probability of depressed reproduction due to chance alone was estimated at 1 case in 253 and hence was attributed to the effects of harassment (Yarmoloy et al. 1988).

Although few mule deer were included in this study, the results revealed highly significant relationships between depressed fecundity and harassment. However, there was no way to discern whether decreased fecundity of the harassed females was due to physiological stress and concomitant depressed fertility or due to the does' behavior and activity patterns that prevented them from mating during the autumn reproductive period. Certainly, mule deer exhibit physiological responses to disturbances even though they do not show overt behavioral changes. Studies of tame and wild mule deer equipped with heart rate radio telemetry have shown that when people walked by standing and grazing deer, the animals' heart rate increased immediately but returned to a pre-stimulus level very slowly (Freddy 1979). Heart rate levels have been directly correlated to energy expenditures in captive mule deer fawns (Kautz et al. 1981) and the heart rate and metabolic rate of any animal

increases with increased activity. While heart rate measurements of free-ranging ungulates have indicated animals' alarm response to stimuli (Ward et al. 1976, MacArthur et al. 1982), no studies have shown that alarm and chronic stress due to unescapable human-related activities in wildlife habitats cause pathological conditions that increase mortality or impair reproductive function as described in laboratory rats (Pollard et al. 1980).

<u>Summary</u>

1. Only two unpublished studies were found that specifically examined mule deer response to oil and gas well development. Neither study demonstrated that mule deer were displaced by the developments.

2. A ten-year study of impacts of surface coal mining to mule deer found that the deer population increased 778%, from 90 to over 600 animals, in spite of extensive increases in coal mining activities and concluded that no net deleterious impacts to deer occurred.

3. Hunted mule deer characteristically seek escape cover during the hunting season and hunting may predispose deer to avoiding roads. Never-the-less, deer have adapted to hunting and have not been displaced from their traditional ranges by it. In fact, many hunted herds, such as the Big Piney - LaBarge Herd, have increased substantially in numbers in the presence of heavy hunting pressure.

4. Since mule deer are known to habituate and adapt to the life-threatening pressures of being hunted, it is only logical that they could even more readily habituate to the less intensive pressures associated with being exposed to petroleum industry developments.

5. Mule deer appear to habituate to vehicular traffic on well-traveled roads but tend to avoid infrequently used roads where hiding cover is absent. If adequate habitat is available away from roads, mule deer will use it more than habitat adjacent to roads.

6. The overwhelming impact of roads on mule deer is mortality due to collision with vehicles. Generally, vehicle-related mortality of deer will increase as traffic volume and deer present in the vicinity of roads increase. The latter occurs as deer migrate to and from winter range and/or are concentrated on winter ranges adjacent to roads.

7. Mule deer respond more vigorously to people on foot than to moving vehicles including snowmobiles and ATVs. When these recreation vehicles move in predictable patterns, deer habituate to them.

8. Constant harassment of female mule deer has been shown to affect their behavior so they avoid disturbances by utilizing cover, shift feeding to periods of darkness, respond strongly to disturbing stimuli, and frequently leave their home range.

9. Controlled harassment of female mule deer probably caused their decreased reproduction although it was not determined if physiological stress and/or behavior, preventing them from mating, depressed their fecundity. Chronic stress has been hypothesized to promote pathological conditions in free-ranging animals that could increase their mortality and decrease reproduction but has not been demonstrated for mule deer. Harassment, though, will increase energy expenditures by deer.

10. Where non-hunted mule deer are exposed to human activities over long periods of time they habituate so completely that they may create hazards or nuisance to humans.

PART 6. SUMMARY AND EVALUATION

Rocky Mountain Oil and Gas Association (RMOGA) contracted Hayden-Wing Associates (HWA) to review and evaluate the impacts of oil and gas development on wildlife habitats on the CAP, and to assess the relevance of current regulations that have imposed by the BLM. This report is a summary of information needed to evaluate stipulations specific to mule deer that can be applied to leases for winter drilling on the Big Piney-LaBarge mule deer winter range. Stipulations on oil and gas drilling within mule deer crucial winter range on the CAP are applied to similar situations throughout Wyoming. These regulatory measures were developed to protect important mule deer winter habitat from November 15 to April 30 from drilling and other surface disturbances. They apply only to oil and gas leases at the time of issue and not to maintenance and operation of producing wells. One key element in evaluating the stipulation prohibiting drilling on crucial mule deer winter range is the actual value of that winter range to the animals. In general, crucial range has been defined as the determining factor in a population's ability to maintain itself over the long term, usually at or above the population objective level specified by the WGFD.

Use of the stipulation implies there would be adverse impacts to mule deer if drilling was allowed within defined crucial winter range during the period from November 15 to April 30. Impacts to mule deer would be considered significant if there was any adverse change in the population's birth rate, growth, and/or survival of individuals as a result of oil and gas developments. Impacts could result from activities that directly decrease the population level, such as through collisions of animals with vehicles or harassment that in some way decreases fecundity. Additionally, impacts to mule deer can occur through habitat alterations due to development, whether through destruction, structural changes, subdivision by barriers, or otherwise rendering habitats unavailable that, for example, might occur if development activities cause mule deer to vacate otherwise suitable habitat.

Summary

Currently, the Wyoming Range mule deer population is substantially larger than the objective level of 38,000. The population has been increasing since winter 1983-1984 because winter conditions since then have been mild. At the end of hunting season in 1989, the population was estimated at 52,588 mule deer compared to an estimate of 23,544 at the end of hunting season in 1984. Production of fawns has also increased from 70 fawns:100 does in 1984 to 90 fawns:100 does in 1988. During the five-year period the Wyoming Range mule deer population increased 123%.

In the same span of time, 5 oil wells were drilled in Townships 26N-28N, Range 113W, on or in the vicinity of the Big Piney-LaBarge mule deer crucial winter range during winters between December 1984 and April 1989. A total of 65 wells were drilled in that area during all months from 1984 through 1989 (USDI-BLM 1990b). From these data

alone, there is no indication that oil and gas drilling has had an adverse effect on the Wyoming Range mule deer population.

However, no studies have been conducted that specifically examined the effects of oil and gas well drilling or well maintenance and operation on wintering mule deer on the Big Piney-LaBarge winter range. Other information, though, has been collected and evaluated on the Big Piney-LaBarge mule deer winter range, including the following:

1. Distributions of mule deer observed during mild, normal, and severe winters since winter 1978-1979 have been mapped and these data have been used to define crucial winter ranges within the total winter range.

2. Vegetation within defined crucial winter range was evaluated. Over 60% of the shrub-producing habitats used by mule deer were found to be in fair to poor condition with shrubs judged incapable of perpetuation.

3. Behavior study of three collared mule deer on the winter range indicated they were habituated to vehicles traveling on existing roads but no observations of deer on areas distant from roads were made for comparative evaluations.

4. Estimates of minimum fawn mortality rates on the Big Piney-LaBarge winter range and three other winter ranges within the Wyoming Range mule deer herd unit indicate that fawn mortality is much higher than expected based on conditions of winter temperatures and precipitation. Winters on the Big Piney-LaBarge winter range are drier and warmer than on the other three winter ranges studied, and yet minimum fawn mortality rates are comparable to those on ranges where winter conditions are more severe.

5. Other situations exist on the Wyoming Range mule deer herd unit that have been documented as adverse impacts on mule deer. Up to 18% of the estimated total fawn mortality during winter on the Cokeville-Rock Creek winter range has been caused by collisions of deer with vehicles and trains. No impacts by vehicles at similar levels are believed to occur on the Big Piney-LaBarge winter range even though there is more human activity, primarily oil and gas developments, than on other winter ranges in the Wyoming Range herd unit. However, mule deer have also been killed by vehicles on highways elsewhere in the herd unit (Harry Harju, 1990, Wyoming Game & Fish Department, Cheyenne, personal communication with A. Reeve, HWA).

The reasons for the unexpected elevated minimum fawn mortality rates observed on the Big Piney-LaBarge winter range are unknown but could include the following:

1. Poor forage conditions resulting from over-utilization by deer, other native ungulates, and livestock and/or drought conditions.

2. Intra-specific competition wherein adult deer out-compete fawns for available high quality forage.

3. Inter-specific competition of other native ungulates and livestock that occupy the winter range with mule deer fawns.

4. Loss of habitat due to surface disturbances by oil and gas developments and other land uses.

The computerized search of available scientific literature and reports found no studies in which all the environmental factors that can affect overwinter mortality of mule deer fawns on the Big Piney-LaBarge winter range, or any other winter range, were evaluated.

Only two studies have been found that have examined mule deer responses to oil and gas development. Neither study conclusively documented that deer are displaced by well drilling and operation. Other scientific literature reporting mule deer response to hunting has documented increased use of cover by deer during the hunting season. And, hunting appears to sensitize deer to other sources of disturbance such as traffic and recreation vehicles. Vehicles on highways are predictable in space and mule deer appear to habituate to highway traffic. However, vehicular collisions with deer, particularly during their migrations and when deer are concentrated on winter range, can be a substantial source of mortality. No similar direct mortalities of mule deer have been documented for other potential impact sources that are associated with the petroleum industry.

Except when harassed by humans, mule deer appear to habituate to human-related activities. Harassment, though, has been shown to reduce fawn production by female mule deer. Whether the depressed fecundity was a result of the does' behavior that prevented them from mating or was caused by physiological stress with decreased fertility, fetal resorption, or abortion was not addressed in the harassment study. If, because of harassment during the mating period, female mule deer never came into contact with males, there are really no implications of that study for human activities during winter on mule deer winter ranges. Alternatively, if physiological stress due to harassment caused reproductive failure, similar effects to wintering deer could occur and be an adverse impact.

Chronic stress has been hypothesized to promote pathological conditions in free-ranging animals, increasing their mortality and decreasing reproduction, but has not been demonstrated for mule deer. Harassing deer on winter range, though, will cause them to expend more energy to escape and avoid the source of disturbance and possibly other, benign human activities. Increased winter mortality is a likely consequence for wintering

deer, particularly females, if they are subjected to over-crowding, poor forage conditions and availability because of snow cover, and the metabolic demands of thermal stress and fetal development.

Evaluation

HWA's evaluation of current oil and gas well drilling lease stipulations is based on the following available information:

1. The Wyoming Range mule deer population and population growth,

2. Vegetation condition on the Big Piney-LaBarge winter range,

3. Potential for and demonstrated habituation of mule deer to some forms of human activity on the winter range,

4. Estimated levels of fawn mortality on the Big Piney-LaBarge winter range,

5. Demonstrated effects of vehicles on mule deer mortality and human harassment on mule deer reproduction.

It has not been demonstrated that oil and gas development on the Big Piney-LaBarge winter range has had an adverse effect on mule deer population growth or reproduction within the Wyoming Range herd unit. There is the potential for direct mortality of deer due to collisions with petroleum industry vehicles as well as non-industry vehicles on roads developed and maintained during winter for well maintenance and operation. With access throughout the winter range, there is potential for people to harass mule deer, whether from existing roads or from off-road vehicles. HWA concurs with the recommendation by BLM that the petroleum industry close roads that are unnecessary for maintaining oil and gas operations. However, because of slower driving speeds, general lack of nocturnal use, and lower volumes of traffic on oil and gas roads, it is not reasonable to hypothesize that indirect impacts on mule deer by oil and gas developments are in any way comparable to direct impacts caused by the public use of highways located in mule deer habitat.

There appears to be no need or justification for disallowing drilling operations on the Big Piney-LaBarge mule deer winter range between November 15 and April 30. It is evident that the mule deer population has continued to grow over a period of 40 years of concurrent drilling and well operations on areas currently designated as crucial winter range. Except for possible direct mortality of deer due to collisions with vehicles, the aspect of oil and gas development most detrimental on the Big Piney-LaBarge winter range is removal of habitat by surface disturbances associated with roads, well pads and ancillary facilities. This, coupled with the poor condition of much of what has been

designated as crucial winter range makes the integration of shrubs into reclamation programs imperative.

Establishing vigorous shrub vegetation on the Big Piney-LaBarge winter range will off-set habitat temporarily removed from mule deer utilization by oil and gas developments. Surface disturbances will occur whether wells are drilled during winter or at other times of year. The net effect of removing mule deer habitat will be the same since there is no indication that mule deer are displaced from habitats adjacent to roads or oil and gas developments, except possibly during the hunting season. Although the general principles and many of the circumstances involved in this evaluation may be applicable to other situations on other mule deer ranges, each development and its site specific conditions must be assessed independently and this evaluation is not intended as a generalized or universal statement of the effects of oil and gas developments.

PART 7. CONCLUSIONS

In consideration of the analyses of existing facts pertaining to this circumstance, the review of applicable literature, and the professional experience and judgement of the reviewers it is concluded that:

1. The long-term extensive growth of this herd in the face of substantial, simultaneous oil and gas activities is evidence that oil and gas activities have not had a significant negative effect on mule deer numbers on this winter range. Mule deer numbers have increased greatly over time in spite of the continuous and simultaneous occurrence of competition with domestic livestock for forage, annual hunter harvest pressures, and long-term oil and gas developments which have included some winter drilling.

2. The conclusion that oil and gas developmental activities have neither displaced nor depressed this mule deer population is in keeping with what is known about mule deer behavior and information reported in the limited literature. All available information on mule deer indicates that this species is highly adaptive to human activities and, given enough to eat, protection from collisions with motor vehicles, and no direct harassment, will thrive and increase in the midst of such activities.

3. The nature of oil and gas activities on this winter range is of the type to which mule deer are expected to adapt. Such activities are stationary and predictable, involve people either in vehicles or in limited, small areas, are long-term, and do not involve the direct harassment or pursuit of deer.

4. The principle constraint confronting the existing population of mule deer is a habitat limitation, in that the number of deer present exceeds the population objective and, the long-term capacity of the range to support them. Although deer numbers on this range have recently increased as the result of successive mild winters and low hunter harvest, the overall problem of having more deer than the forage resource can sustain on a long-term basis is a long-standing one. The history of overuse of forage in general on this range by deer and livestock is extensive and the important mountain shrubs community here has been severely damaged by excessive use by mule deer (Harry Harju, 1990, Wyoming Game & Fish Department, Cheyenne, personal communication with L.D. Hayden-Wing). As long as the deer population remains high and increases, it will continue to over-use and damage the browse resource and will further decrease the capacity of the winter range to support deer. This situation is exacerbated, but not created by competition with domestic livestock for range management priority (shrub management vs grass management), and further removal of browse forage by oil and gas developments.

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APPENDIX A

APPENDIX A. Summary of NWS cooperator data for stations within each winter range included in the Wyoming Range Mule Deer Winter Mortality Study. Data recorded during the severe winter of 1983-1984 is provided for comparisons. MMdt is the mean maximum daily temperature (degrees F) and Ppt is the total monthly precipitation (inches of water).

Winter Range	NWS Station	Month	1983-1984 MMdt	1983-1984 Ppt	1986-1987 Mdt	1986-1987 Ppt	1987-1988 MMdt	1987-1988 Ppt	1988-1989 MMdt	1988-1989 Ppt	1989-1990 MMdt	1989-1990 Ppt
BP-La	Big Piney	November	M	M	M	0.15	M	0.72m	M	0.43	M	0.40
		December	M	1.39	M	T	M	0.31	M	0.30	M	0.00
		January	M	0.18	M	0.47	M	0.72	M	0.15	28.0	0.27
		February	M	M	M	M	M	0.00	M	0.29	29.3	0.03
		March	M	M	37.5m	0.26m	M	0.31	M	0.77	43.6	1.17
BP-La & SC-FC	LaBarge	November	40.5	1.83	43.1	0.02	42.4	0.55	40.7	0.62	46.6	0.46
		December	20.4	1.29	36.5	0.00	31.4	0.26	30.0	0.40	37.0	0.10
		January	M	M	27.8	0.38	31.2	0.17	30.5	0.19	34.2	0.31
		February	M	M	37.5	0.51	42.3	0.00	26.7	0.39	35.2	0.03
		March	M	M	41.7	1.07	41.8m	0.30	45.8	0.48	44.8	1.67
SC-FC & C-RC	Kemmerer	November	37.6	3.05	40.9	0.74	39.8	0.86	36.8	2.01	42.7	0.64
		December	23.9	3.21	35.9	0.12	28.3	0.75	27.0	0.44	30.5	0.33
		January	24.7	0.66	26.0	1.15	25.7m	1.14	28.5	0.38	31.7	0.99
		February	30.4	0.48	36.3	0.59	33.6	0.43	25.0	1.57	30.5	0.48
		March	36.1	0.54	41.6	1.80	39.6	0.84	44.9	1.75	44.8	1.67
C-RC	Border	November	39.2	2.82	41.0m	0.62m	37.3	1.86	M	M	43.0	0.80
		December	24.6	2.93	34.2	T	25.7m	0.86	22.1	0.49	24.5	0.30m
		January	20.2	0.09	23.1	1.02	20.3	1.40	20.3	0.50	27.8	1.30
		February	24.8	0.53	32.1	0.74	25.4	0.33	20.4	1.61	26.5	0.35
		March	37.2	0.55	41.3	0.44	35.6	0.56	39.6	1.33	43.0	0.97
C-RC	Sage	November	39.1	0.76	43.5	T	37.4	1.29	39.3	0.97	45.6	0.31
		December	19.9	0.60	36.5	T	27.7	M	26.4	0.12	29.2	0.00
		January	15.6	M	26.0	0.20m	23.4	M	25.3	0.00	30.8	0.48
		February	23.9	0.05m	37.3	M	30.1	T	21.7	0.43	30.6	T
		March	37.2	0.00m	44.7	0.40	40.5	T	47.5	0.93	48.5	0.40
SVF	Afton	November	M	M	40.1	1.28	42.4	1.46	37.9	2.56	M	0.60m
		December	27.6	2.83	M	M	29.6	0.99m	25.9	1.08	27.8	0.75
		January	25.9	0.84	25.8	1.18	27.0	1.23	26.6m	0.71m	31.9	1.58
		February	31.2	1.05	35.9	0.72	32.4m	0.63	28.5	1.34	31.9	1.65
		March	41.7	2.16	42.1	0.41	40.5	0.75	44.1	3.14	45.2	1.22

Notes: Letters are: m = some data missing; M = too much missing data to include; T = trace of precipitation.

SECTION B

NESTING HABITAT EVALUATION

FOR SAGE GROUSE

With Applications for

Oil and Gas Developments on the

Coordinated Activity Plan Area, Pinedale Resource Area

INTRODUCTION

In 1986, USDI-Bureau of Land Management (USDI-BLM) developed a standard set of stipulations to be applied to oil and gas leases on Wyoming lands under their jurisdiction. Some stipulations serve to designate special environmental conditions that may modify development and operations on portions of the lease (USDI-BLM 1987a, 1989). For sage grouse (Centrocercus urophasianus), two potential stipulations that can be applied to leases are:

1. No drilling and other surface disturbances are allowed from February 1 to July 31 within areas that are designated as nesting habitat for raptors, sage grouse and/or sharp-tailed grouse.

2. Restrictions on activities or surface use can be applied to a specified area (with legal description) to protect specific habitat (sage grouse or sharp-tailed grouse leks and/or other species during their annual cycle).

Within the Pinedale Resource Area and other areas in Wyoming that are managed by USDI-BLM, specific restrictions include no activities or surface use allowed from February 1 through July 31 in an area up to 2 miles from a sage grouse lek (USDI-BLM 1987b). In addition, no activities or surface use will be allowed on areas identified as having unique wildlife habitat or unique wildlife values (areas which cannot be protected with seasonal restrictions). An example is sage grouse leks for which a 1/4 mile buffer may be required, but distances may vary (USDI-BLM 1990, pages 7-8).

Female sage grouse typically reach their peak attendance at leks during April, several weeks before maximum male attendance (Jenni and Hartzler 1978). After fertilization, female sage grouse lay eggs over a 10-day period and require 25-27 days to incubate the clutch (Johnsgard 1973) and nesting can begin by the end of April. Investigations of sage grouse nest-site character-istics in the Rocky Mountain region provide quantifiable parameters that can be used to evaluate areas of potential nesting habitat. These are summarized from scientific literature, below.

Hayden-Wing Associates (HWA) proposes that not all areas within a 2-mile radius of a sage grouse lek are equally suitable for nesting grouse. Rather than apply a standard stipulation to an oil and gas drilling lease, HWA presents procedures to evaluate specific areas that are planned for oil and gas development. Potential sage grouse nesting habitat can be evaluated for characteristic in four site-specific categories, including: 1) distance relationships to leks, 2) presence, distance, and characteristics of existing disturbances, 3) characteristics of shrubs and vegetation that could serve in nest concealment and nest-site selection, and 4) distance to water and to potential brood-rearing areas.

LITERATURE REVIEW

Proximity to leks - Studying the movements of radio-telemetered sage grouse hens in Montana, Wallestad and Pyrah (1974) determined that 64% of them nested from 0.51 to 1.50 miles (0.8-2.4 km) from a lek. Martin (1976) reported 68% of nesting hens were within 1.5 miles of a lek and that most hens nested within 3 miles (4.3 km). In Idaho, Autenrieth (unpublished data, cited in Braun et al. 1977) recorded all nests of marked hens within 8 miles (12.9 km) of a lek, but 73.4% were within 3 miles and 59% were within 2 miles (3.2 km). Pyrah (1971) found 90% of nesting hens within 3 miles of leks. In northeastern Wyoming, the average distance from leks of nests of radio telemetered sage grouse was 2.02 miles (3.25 km), but none was closer to a lek than 0.70 miles (1.1 km) (Hayden-Wing et al. 1985). In Autenrieth's study, only 28% of all nests were within 1 mile and Wallestad and Pyrah (1974) found only 4.5% of the nests within 0.5 mile of a lek. However, sage grouse nests are not likely to be distributed uniformly around leks (Eng et al. 1980).

Nest cover - Sage grouse nest on the ground and nest concealment is particularly important for nest success. Pyrah (1971) noted that successful nests had more sagebrush with greater canopy cover in the immediate vicinity than unsuccessful nests. In Montana, Martin (1976) found nesting hens preferred stands of sagebrush with 20-30% canopy cover and successful nests were found where canopy cover was greater within 24 inches of the nest than canopy cover in the vicinity of unsuccessful nests. Likewise, Wallestad and Pyrah (1974) documented a mean canopy cover of 27% at successful nests but only 20% cover at unsuccessful nest sites. Sagebrush canopy cover at 12 nests in Wyoming ranged from 5% to 58% with a of mean 25.1% canopy cover (Colenso et al. 1980). Typically, sage grouse nest beneath shrubs that are taller and have a greater diameter than other shrubs in the immediate vicinity (Hayden-Wing et al. 1985).

Shrub height is important to nesting sage grouse. During a two-year study, Hayden-Wing et al. (1985) found nest shrub heights averaged 21.8 inches (55.4 cm), but four shrubs closest to each nest shrub averaged 13.8 inches (35.1 cm). Likewise, Colenso et al. (1980) found an average height of sagebrush plants under which there were nests to be 20.6 inches (52.3 cm), significantly taller than shrubs in the general nest-site vicinity which averaged 10.5 inches (26.7 cm). Pyrah (1971) observed a range of sagebrush heights at nests between 14 and 22 inches (35.6-55.9 cm) while Patterson (1952) reported nests under plants 10-20 inches (25.4-59.8 cm) tall. Klebenow (1969) recorded an average shrub height of 17 inches (43.18 cm) at nest sites. Braun et al. (1977) also concluded that the tallest sagebrush at a given site is selected for the nest location.

Nesting density in Utah was greatest in second growth sagebrush with understories of grasses and forbs rather than sagebrush without an herbaceous understory (Rasmussen and Griner 1938). Herbaceous vegetation ground cover at 10 nest sites in northwestern

Wyoming ranged from 22% to 48%; the average herbaceous cover was 34.3% (Hayden-Wing et al. 1985).

Density of shrubs at nest sites adds to nest concealment. In Utah, Rasmussen and Griner (1938) found that stands of silver sagebrush (Atremisia cana) with understories of herbaceous vegetation were used most for nesting and nests in very dense stands were most successful. During sage grouse nesting in May, Colenso et al. (1980) reported that most sage grouse fecal droppings were associated with an average sagebrush density of 11.4 plants/square meter, significantly greater than the study area mean of 1.3 plants/square meter. Shrub density influences shrub cover and optimal nesting cover, according to Patterson (1952), ranged from 20 to 40% shrub cover. But, Klebenow (1969) concluded that total shrub cover in the vicinity of nests in Idaho was 18.4% compared with 14.4% shrub cover in non-nesting areas.

Brood habitat - Prior to the brood-rearing period, sage grouse consume big sagebrush (Artemisia tridentata), forbs (especially dandelion (Taraxacum sp.)), and some insects (Rasmussen and Griner 1938, Rogers 1964, Wallestad 1975, Wallestad et al. 1975). However, following hatching, diets of sage grouse chicks are 60% insects (Peterson 1970). Heavy use of insects declines as chicks grow older and forbs are predominant in their diet (Leach and Hensley 1954, Klebenow and Gray 1968, Peterson 1970, Wallestad 1975, Martin 1976). Forb-producing areas utilized by sage grouse during late spring and summer include hay meadows, greasewood bottoms, stream banks, alfalfa fields, playas, borrow pits, and roadsides with herbaceous vegetation (Rasmussen and Griner 1938, Gill and Glover 1965, Wallestad 1971, Hayden-Wing et al. 1985). In Wyoming, no nests of telemetered grouse were beyond 0.3 mile (0.5 km) from mesic, forb-producing vegetation and during the first 30 days after hatching, broods remained within 1 mile (1.6 km) of their nest sites (Hayden-Wing et al. 1985).

Marked sage grouse in Colorado moved up to 7 miles (11.3 km) from leks to summering areas (Gill and Glover 1965). In Wyoming, Postovit (1981) noted increased distance of grouse movements away from the lek in summer. Whereas 81% of all telemetered grouse locations were within 1 mile of a lek during the breeding period, only 20% of all relocations between May and August were within 1 mile (Postovit 1981). Daily movements of sage grouse broods range from 0.25 to 0.50 miles (0.4-0.8 km) (Wallestad 1971, Gill and Glover 1965, Martin 1976).

Wallestad (1971) noted sage grouse use of free-standing water during summer was probably limited and depended on forb succulence, hence precipitation. Klebenow (1969) questioned whether free-standing water is ever consumed by sage grouse in Idaho. But, Patterson (1952) suggested that sage grouse populations reach their highest densities where water is present and Dalke et al. (1963) noted morning water consumption by grouse but did not indicate their frequencies of use. In Utah, Rasmussen and Griner (1938) reported sage grouse were rarely found beyond 1 mile from water. And in northeastern Wyoming,

all nests of telemetered grouse were 1.3 miles (2.1 km) or closer to open water, with an average distance of 0.62 mile (1.0 km) (Hayden-Wing et al. 1985).

Disturbances - No specific studies have been found that document the tolerance of nesting sage grouse to existing disturbances or the presence of man-made structures. Mortality of sage grouse has been attributed to collision with vehicles, aerial collisions with fences (Rogers 1964) and with telephone lines (Borell 1939). In general, wildlife are expected to become habituated to benign, predictable stimuli (Geist 1970, Bromely 1985). If habituation does not occur, then free-ranging animals are expected to avoid obnoxious disturbances.

In general, animals can acclimate to sound (Ames 1978, Golden et al. 1980). Typically, noise levels decrease with distance from the source: a 6-dBA decrease for every doubling of distance and atmospheric adsorption of one dBA per 100 feet (30.5 m) (Golden et al. 1980). In this respect, sound levels of the following vehicles have been quantified at 50 feet and 400 feet (15 and 122 m), respectively (Golden et al. 1980): Mack truck: 84 and 66 dBA; passenger auto: 69-76 and 51-58 dBA; motorcycle: 82 and 64 dBA. Within the same distances, heavy construction equipment can produce noise levels ranging between annoying (65 dBA) and painful (127 dBA) to humans: heavy trucks: 84-89 and 66-71 dBA; scraper: 80-89 and 60-71 dBA; dozer: 87-102 and 69-84 dBA. Normal human speech levels are 55-60 dBA (Golden et al. 1980). By comparison, sound levels measured in aspen and confer sites range from 20 dBA with no wind to 56 dBA under windy conditions (Ward et al. 1976). No reports of ambient sound in sagebrush habitats, with or without wind, have been found.

NESTING HABITAT SUITABILITY CRITERIA

The sage grouse nesting habitat suitability criteria for each important parameter shown to influence nesting are defined for 1) habitat that is not suitable or has low suitability and therefore is of limited value to sage grouse during the nesting season, 2) habitat that is suitable for nesting and in which nests might be found. Further, nest site characteristics that have been adequately described in the literature can be used to define suitable habitat as 1) moderately suitable with some chance of nesting, or 2) habitat that has high suitability for sage grouse during the nesting period and in which nests are likely to be found.

Distance From Leks

1. Not suitable or low suitability - Distance of site from nearest lek is greater than 2 miles (3.22 km).

2. Suitable - Distance of site from nearest lek is within 2 mile.

Distance to Existing Disturbance

1. Not suitable or low suitability - Distance to a disturbance where grouse could be killed or to a disturbance that is unpredictable and obnoxious to grouse is less than 500 feet (150 meters).

2. Suitable - Distance to a disturbance (described, above) is greater than 500 feet or less than 500 feet if the disturbance is benign and predictable.

Shrub Density

1. Not suitable or low suitability - Less than 0.14 shrub/square meter (1 shrub/7.1 square meters or 4 shrubs within a 3-meter radius).

2. Suitable - Shrub density is greater than 0.14 shrub/square meter.

Shrub Height

1. Not suitable or low suitability - Average shrub height is less than 10 inches (25 cm) or greater than 27 inches (69 cm).

2. Moderate suitability - Average shrub height is between 10 and 15 inches (25-38 cm) or between 22 and 27 inches (56-69 cm).

3. High suitability - Average shrub height is greater than 15 inches (38 cm) and less than 22 inches (56 cm).

Shrub Canopy Cover

1. Not suitable or low suitability - Average shrub canopy cover is less than 10% or greater than 50%.

2. Moderate suitability - Average shrub canopy cover is between 10% and 18% or between 32% and 50%.

3. High suitability - Average shrub canopy cover is greater than 18% and less than 32%.

Herbaceous Understory Cover

1. Not suitable or low suitability - Herbaceous cover is less than 10% or greater than 80%.

2. Moderate suitability - Herbaceous cover is between 10% and 20% <u>or</u> between 60% and 80%.

3. High suitability - Herbaceous cover is greater than 20% <u>but</u> less than 60%.

<u>Distance to Water</u>

1. Not suitable or low suitability - Distance is 1.5 miles (2.4 km) or more.

2. Moderate suitability - Distance is between 1.0 and 1.5 miles (1.6-2.4 km) if there are other sites closer to water within a 2-mile radius of a known lek.

3. High suitability - Distance is less than 1.0 mile (1.6 km) <u>or</u> the site is closer to water than any other within a 2-mile radius of a known lek.

<u>Distance to Brood Habitat</u>

(Brood habitat can be any of the following: hay meadows, greasewood bottoms, alfalfa fields, ephemeral or permanent stream banks, playas, borrow pits, roadsides with herbaceous vegetation.)

1. Not suitable or low suitability - Distance to potential brood-rearing habitat is greater than 5 miles (8.1 km).

2. Moderate suitability - Distance is between 0.75 and 5 miles (1.3-8.1 km).

3. High suitability - Distance is less than 0.75 mile (1.3 km).

METHODS

Areas in which construction activities may occur during sage grouse nesting, from May 1 through June 1, can be evaluated for potential sage grouse nesting habitat by using the following procedures and the habitat suitability criteria, above. A sample data sheet is provided (Appendix A) showing the measurements that will be taken at each sample point. Based on these measurements, summary evaluations of each sample point, whether it was within habitat with low, moderate, or high suitability for sage grouse nesting, will be used to map potential nesting habitat in relation to planned construction projects. A hierarchial, dichotomous approach to determine the suitability of habitat for sage grouse nesting is shown in Table 1.

<u>Distance From Leks</u> - Only those sites within 2 miles of a known lek will be evaluated. Sites greater than 2 miles from a lek are considered to have low suitability for nesting sage grouse.

Existing Disturbances - The distance from known disturbance sources to evaluation sites will be determined from topographic maps. The type of disturbance will be evaluated on-site to determine its frequency, predictability, and whether the potential to kill grouse exists. Specific sampling designs will vary depending on the nature of existing disturbances. If a road, highway, or railroad is proximate to the evaluation site, vehicle counts can be conducted while evaluating vegetation characteristics, below. If necessary, one can determine the frequencies of visual or auditory disturbances during performance of other tasks.

Vegetation Characteristics - Areas in which construction may occur and that are within a 2-mile radius from a known lek will be sampled for the following vegetation characteristics: 1) shrub species and shrub density, 2) shrub density, 3) shrub canopy cover, and 4) herbaceous understory cover beneath and surrounding shrubs. Sample measurements will be made every 50 meters (164 feet, approximately 66 paces) or less along the line or perimeter of the proposed construction project. Additional sampling may be required, depending on the nature of the project.

Point-centered quarter sampling (Morisita 1957, Laycock and Batcheler 1975) will be used at each 50 meter interval to measure the following within each quadrant if shrub vegetation is present: 1) distance to the outer edge of the nearest shrub, if not more than 3 meters from the center point, 2) the height of each shrub measured in #1, 3) the crown distance (greatest diameter) of each measured in #1, and 4) the herbaceous cover within 0.5 meter of the center of each shrub, measured in #1. Measurements #2, #3, and #4 will not be made if the average distance to the nearest shrub in each quadrant is greater than 3 meters (density of less than 0.14 shrub/square meter).

Distance to Water and Potential Brood Habitat - Distances to these features from the evaluation site can be determined from topographic maps.

Habitat Suitability Ranking - Table 1 lists habitat parameters and alternative conditions that would define habitat with low suitability (Alternative A) and habitat suitable for sage grouse nesting (Alternative B). Only two ranks are possible for distance to leks, distance to disturbances, and shrub density: not suitable (low suitability) or suitable. As constructed, the order of the parameters determines which additional parameters need to be measured. Once a sample point is judged to be in habitat with low suitability, no additional information is needed. If measurements suggest that Alternative B is appropriate for each parameter, then the sample site can be rated as moderate to high suitability for nesting sage grouse, depending on the range of measured values within the specified suitability criteria values listed, above.

If criteria for distance to leks, distance to disturbances, and shrub density indicate the habitat is suitable, parameters for shrub height, shrub canopy cover, distance to water, herbaceous cover, and distance to brood habitat are used to rank suitable habitat as being

moderately or highly suitable for nests. For each parameter with measured values in the "moderate suitability" range, a score of 1 is assigned. If measured values are within the "high suitability" range, a score of 2 is assigned. The scores are totaled for all 5 parameters. A sample point is summarized as having "Moderate Suitability" if the total score is between 5 and 7. If the total score is between 8 and 10, the sample point site is designated as having "High Suitability" for nesting sage grouse. With each sample point located on a topographic map, habitat that is ranked with low, moderate, and high suitability for nesting grouse can also be mapped and compared to the location of construction activities.

CONCLUSIONS

In consideration of the foregoing presentation of facts and the professional judgement of the reviewer it is concluded that:

1. Not all areas within a 2-mile radius of a sage grouse lek are equally suitable for nesting grouse.

2. In view of conclusion #1 it follows that the current restriction in which no activities or surface use is allowed within the area included in a 2-mile radius surrounding a sage grouse lek from February 1 though July 31 is unnecessarily restrictive.

3. A more equitable and site-specific method for determining potential impacts to nesting sage grouse should be adapted and applied.

TABLE 1. Step-wise evaluation of habitat suitability for sage grouse nesting.

STEP	PARAMETER	ALTERNATIVE	DECISION
1.	Distance From Lek	A. > 2 miles	Low Suitability, No Additional Evaluation
		B. < or = 2 miles	Continue, Step 2
2.	Existing Disturbance	A. < 500 feet and obnoxious or fatal to grouse	Low Suitability, No Additional Evaluation
		B. Not Alternative A	Continue, Step 3
3.	Shrubs Present	A. Shrub density < 0.14 shrub/m2	Low Suitability, No Additional Evaluation
		B. Shrub density > 0.14 shrub/m2	Continue, Step 4
4.	Shrub Height	A. Average height < 10 inches	Low Suitability, No Additional Evaluation
		B. Average height > 10 inches	Continue, Step 5
5.	Shrub Canopy Cover	A. Canopy cover < 10% or > 50%	Low Suitability, No Additional Evaluation
		B. Canopy cover > 10% and < 50%	Continue, Step 6
6.	Distance to Water	A. > 1.5 miles	Low Suitability, No Additional Evaluation
		B. < 1.5 miles	Continue, Step 7
7.	Herbaceous Cover	A. < 10% or > 80%	Low Suitability, No Additional Evaluation
		B. > 10% and < 80%	Continue, Step 8
8.	Brood Habitat	A. > 5 miles away	Low Suitability
		B. < 5 miles away	Moderate to High Suitability Rank

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APPENDIX A

SAMPLE DATA SHEET

NESTING HABITAT SUITABILITY
FOR SAGE GROUSE

EVALUATION OF POTENTIAL SAGE GROUSE NESTING HABITAT

Date___/___/___ Observer______________ Project____________________ Sequence______

Start: Time______ Temp.____ Wind Sp./Dir._____ Cl.Cov./Precip.______ Map Point______

End: ______ ____ _____ ______ ______

Disturbance Type: A.______________ B.______________ Events: A.__________ B.________

Distance to Lek: Location:__________________ Active____ Start:_______ End:_______

Point	Quadrant 1				Quadrant 2				Quadrant 3				Quadrant 4				Sample Mean				Distances:		
	Ds	Ht	Cc	Hu	Ds	Ht	Cc	Hu	Ds	Ht	Cc	Hu	Ds	Ht	Cc	Hu	Ds	Ht	Cc	Hu	H20	DB	BRD
1																							
2																							
3																							
4																							
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Abbreviations: Ds=shrub distance, Ht=shrub height, Cc=Crown distance, Hu=% herbaceous understory cover, H20=distance to water, DD=distance to disturbance, BRD=distance to brood-rearing habitat (define types:)

SECTION C

ALTERNATIVE MITIGATION STRATEGIES FOR PROTECTING RAPTOR NESTING HABITATS FROM OIL AND GAS DEVELOPMENT ACTIVITIES

On The

Coordinated Activity Plan Area, Pinedale Resource Area

INTRODUCTION

In 1986, USDI-Bureau of Land Management (USDI-BLM) developed a standard set of stipulations to be applied to oil and gas leases on Wyoming lands under their jurisdiction. Some stipulations serve to designate special environmental conditions that may modify development and operations on portions of the lease (USDI-BLM 1987a, 1989). For nesting and wintering raptors, potential stipulations that can be applied to leases include, 1) no drilling and other surface disturbances allowed from February 1 to July 31 within areas that are designated as nesting habitat for raptors, and, 2) no drilling and other surface disturbances from November 15 to April 30 in defined raptor winter concentration areas.

Within the Pinedale Resource Area and other areas in Wyoming that are managed by USDI-BLM, specific stipulations include no activities or surface use allowed within the following temporal and spatial restrictions for different raptor species (USDI-BLM 1987b):

Raptor Species	Time Restriction	Area Restriction
Golden Eagle Nest	February 1 to July 30	Within 0.5-mile Radius of Nest
Osprey Nest	February 1 to July 30	Within 0.5-mile Radius of Nest
Swainson's Hawk Nest	February 1 to July 30	Within 0.5-mile Radius of Nest
Ferruginous Hawk Nest	February 1 to July 30	Within 1-mile Radius of Nest
Cooper's Hawk Nest	February 1 to July 30	Within 0.5-mile Radius of Nest
Burrowing Owl Nest	February 1 to July 30	Within 0.5-mile Radius of Nest
Merlin Nest	February 1 to July 30	Within 0.5-mile Radius of Nest
Other Raptors	February 1 to July 30	Within 0.5-mile Radius of Nest

The Swainson's hawk (Buteo swainsoni), ferruginous hawk (Buteo regalis), and burrowing owl (Athene cunicularia) are species of special concern in Wyoming and could potentially occur within the Coordinated Activity Plan area. The two hawk species are classified as Federal Category 2 for which the US Fish and Wildlife Service (USFWS) has information that may support listing them as threatened or endangered, but for which substantial biological data are not available to support a proposed rule (USFWS 1985). The burrowing owl has been designated a Priority II species by the Wyoming Game and Fish Department. Priority II species are those needing additional study to determine whether intensive management is warranted (WGFD 1986).

Other raptors listed, above, are protected by federal regulations. The golden eagle (Aquila chrysaetos), osprey (Pandion haliaetus), Cooper's hawk (Accipiter cooperii), and merlin (Falco columbarius) are protected under the Migratory Bird Treaty Act, as are the other three raptor species, and permits from USFWS are required for the take, possession,

transport, sale, and purchase of species (Millsap 1987). Golden eagles receive additional protection through the Eagle Protection Act wherein a permit from USFWS is needed to disturb birds (Millsap 1987).

Disturbances can affect the productivity of nesting raptors. Fyfe and Olendorff (1976) and Grier and Fyfe (1987, pages 175-176) have listed the following potential effects:

1. Desertion of eggs or young by parent birds. The potential for desertion varies between species and within species but is more likely early in the nesting season than after young have hatched (Suter and Joness 1981).

2. Damage to eggs and young by frightened adults. Eggs and young may be accidentally crushed or pushed out of the nest if startled adults suddenly flush.

3. Cooling, overheating, and loss of moisture from eggs or young. If adults are disturbed and remain away from the nest for extended periods, dehydration of eggs and very young chicks can occur. Excessive exposure to heat or cold can occur before chicks can thermoregulate, when they depend on adults for shelter.

4. Missed feedings. If adults frequently remain away from nests for long periods, chicks can starve.

5. Premature fledging. If older nestlings are startled, they jump or fall from the nest before they are capable of flight.

6. Mammalian and avian predators. Nests left unattended are vulnerable to predators. Mammalian predators can follow scents to nests left by human visitors.

<u>Nesting Chronology</u>

According to Call (1978), the chronology of nest-building activities varies substantially between species. For the raptor species listed, above, and others that are likely to occur on the CAP area, the following ranges in dates have been tabulated for nest building, egg laying, incubation, hatching, and fledging (Call 1978, Appendix 4):

Raptor Species	Nest Building	Egg Laying	Incubation	Hatching	Fledging
Golden Eagle	2/02 - 2/26	3/06 - 3/30	3/10 - 5/14	4/02 - 5/14	6/07 - 6/21
Osprey	4/22 - 5/31	5/21 - 6/07	5/25 - 7/10	6/23 - 7/10	7/11 - 8/01

Raptor Species	Nest Building	Egg Laying	Incubation	Hatching	Fledging
Swainson's Hawk	4/13 - 5/09	5/13 - 6/15	5/17 - 6/28	6/16 - 6/28	7/16 - 7/26
Ferruginous Hawk	3/10 - 3/16	3/17 - 4/01	3/21 - 5/21	4/16 - 5/21	6/04 - 7/02
Cooper's Hawk	4/15 - 5/07	4/20 - 5/11	4/26 - 6/22	6/01 - 6/22	7/04 - 8/26
Burrowing Owl	4/17 - 5/25	4/30 - 6/06	5/01 - 6/17	6/04 - 6/17	7/03 - 7/10
Merlin		5/20 - 6/15	5/25 - 6/20	6/10 - 7/10	7/20 - 7/30
Other Raptors:					
Prairie Falcon		4/20 - 5/01	4/28 - 6/06	5/26 - 6/06	7/02 - 7/15
Red-tailed Hawk	2/06 - 3/25	3/05 - 4/21	3/23 - 5/02	4/06 - 5/23	5/16 - 7/01
Great Horned Owl	1/01 - 2/30	1/20 - 4/10	1/25 - 5/12	2/27 - 5/12	3/31 - 6/17

From this table it is obvious that variation in nesting phenology exists between raptor species and within species. Timing of nesting activities will depend on a variety of biological and climatological factors (Steenhof 1987) that may change from one year to another. It is also apparent that the standard time period, February 1 to July 31, for restricting activities or surface use near raptor nests is not appropriate for most raptor species listed above. Nest building can begin as early as January 1 for great horned owls and as late as May 31 for ospreys. Likewise, great horned owl chicks can fledge by March 31 but young Cooper's hawks may not fledge until late August.

Spatial Buffers

The size of buffer zones designed to protect raptor nests from surface disturbances is debatable (Postovit and Postovit 1987). Expert opinions have been shown to vary widely as, for example, a distance range from 91 meters to 2,414 meters for which off-road vehicles would cause a 20% rate of nest abandonment by incubating golden eagles (Suter

and Joness 1981). Again, variation among area and individual birds is expected and site-specific evaluations are the best approach to assigning buffer zones around raptor nests (Postovit and Postovit 1987).

For example, road re-construction occurred approximately 800 feet (240 meters) from a golden eagle nest in late June, when the eaglet was between 9 and 9.5 weeks old. Monitoring the nest during one week of construction indicated no significant disturbance to the chick: the adults regularly visited the nest with food (Hayden-Wing Associates and Powder River Eagle Studies 1989). The eaglet fledged without incident. In this case, disturbances occurred late in the nesting season and along a well-traveled highway to which the adult eagles had probably habituated. Results might have been different if highway construction occurred earlier in the nesting season near a nest hat had not been previously exposed to disturbances.

EVALUATION AND CONCLUSIONS

In consideration of the analyses of existing facts pertaining to this circumstance, the review of applicable literature, and the professional experience and judgement of the reviewers it is concluded that:

1. The potential for oil and gas developments impacting nesting raptors varies extensively depending on many site-specific circumstances such as: time frame of the operation, species of raptor involved, nature and duration of the proposed construction, distance of operation from nest, existence of topographic and vegetative buffering between operation and nest, prior exposure to and tolerance of nesting birds to human activities, etc.

2. The temporal and spatial stipulations proposed by USDI-BLM are too general, categorically exclusive, and unnecessarily restrictive.

3. In addition to the temporal and spatial restrictions proposed by USDI-BLM, a variety of other mitigation strategies for protecting raptor nests have been used successfully in Wyoming and elsewhere in the Western United States during recent years. These procedures include:

    a. Delay of commencement of proximate construction and operations until young birds have hatched. It has been documented for most raptor species that the parent birds are less likely to abandon nests with hatched young in them and the likelihood for abandonment progressively decreases as the chicks get older. Unless construction occurs immediately adjacent to the nest, delaying operations until as long as possible into the post-hatching period will usually prevent nest abandonment while gaining several weeks on construction start-up date.

b. Where the construction start-up date is extremely critical and coincides with the nesting period of a near-by active raptor nest, it has sometimes been practical to move the raptor nest out of the path of construction after the chicks are old enough to tolerate the disturbance. This is an established technique that has been used successfully on golden eagles and other raptor species in Wyoming for the past ten years.

c. The removal and translocation of raptor chicks from their original nest to a foster nest is a procedure that has been used successfully to remove great horned owls from the path of construction and is often used when operation plans dictate the elimination of a nest. Care must be taken to move the young birds when they are still young enough to be accepted by foster parents. Preferably, foster nests with only one young bird in them should be used so that the foster parents are capable of tending to one or two additional chicks. In some cases it is best to use more than one set of foster parent birds and nests.

d. For raptor species that are known to have multiple nest-sites within their nesting territory, a temporary nesting deterrent such as a wire cage placed over an existing nest can be used before adult birds arrive in the spring. This is appropriate if construction plans are known in advance, if disturbances near the affected nest-site last for only one season, and if there has been documented use by raptors of different nest sites other than the affected site.

e. Under some circumstances, Federal and State permits can be obtained to eliminate nests which are in the path of construction which requires permanent modification of the habitat. Nests are taken during the period of non-use. This technique is best used where the affected raptor pair is known to have suitable alternative nest sites or habitat within the area. In cases where suitable alternative nest sites are not available it may be necessary to provide artificial nesting structures.

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USDI-Bureau of Land Management. 1989. Wyoming BLM standard mitigation guidelines for surface-disturbing activities. USDI-BLM Wyoming State Office, Cheyenne, WY.

SECTION D

QUALIFICATIONS OF REVIEWERS

LARRY D. HAYDEN-WING
Director and General Manager

EDUCATION

Ph.D.	Wildlife Ecology	University of Idaho	1969
M.S.	Wildlife Management	University of Idaho	1962
B.S.	Forestry/Wildlife	University of Idaho	1958

QUALIFICATIONS SUMMARY

* 30 years experience as professional wildlife biologist, research scientist, teacher, manager and administrator.
* Experienced with a wide variety of wildlife species and habitats, including forest, range, cropland, and aquatic ecosystems.
* Performed wildlife work in ten western states and one foreign country. Traveled in all states except Alaska.
* Project manager for baseline wildlife assessments and permit applications for coal mines, uranium mines, gravel pits, transmission line corridors, and oil field development.
* Extensive experience base with Threatened and Endangered species, as well as those classified as being of "High Interest" to state or federal agencies.
* Technical counsel and expert witness experience at hearings and in court.
* Author/editor of numerous technical reports, public presentations, and scientific publications.

AREAS OF SPECIALIZATION

* Impacts of Energy Development on Wildlife
* Wildlife Impact Mitigation and Habitat Restoration
* Wetland Evaluation, Reclamation, and Mitigation
* Wildlife Inventory and Survey Techniques
* Wild Ungulate Management and Ecology
* Wildlife Ecology and Management
* Wilderness Research and Management
* Biogeochemistry of Pesticides
* Western Wildlife
* Plant/Animal Relationships/Range Analysis
* Wildlife Education

HAYDEN-WING, Larry D.

PROFESSIONAL EXPERIENCE

1980 - Present	Director and General Manager, Hayden-Wing Associates, Sheridan, Wyoming.
1978 - 1980	Director, Wildlife Division, Mine Reclamation Consultants, Laramie, Wyoming
1977 - 1978	Associate Professor of Wildlife Ecology and Management, Department of Zoology, University of Wyoming, Laramie.
1972 - 1977	Associate Professor of Wildlife Management, Department of Animal Ecology, Iowa State University, Ames.
1969 - 1972	Assistant Professor of Animal Ecology and Wildlife Conservation, Department of Animal Ecology, Iowa State University, Ames.
1965 - 1969	Wildlife Research Associate, College of Forest, Range, and Wildlife Resources, University of Idaho, Moscow.
1962 - 1965	Wildlife Research Biologist, Uganda, East Africa, Department of Zoology, Washington State University, Pullman.
1960 - 1962	Wildlife Research Associate, College of Forest, Range, and Wildlife Resources, University of Idaho, Moscow.
1958 - 1960	Lt.(j.g.) and Ensign, U.S. Navy, San Diego, California.
1953 - 1958	Wildlife Student Trainee (summer/fall), Idaho Department of Fish and Game, U.S. Forest Service, and University of Idaho.

PROFESSIONAL SERVICE AND ACTIVITIES

Member of U.S. People to People Forest and Wildlife Management Delegation to the People's Republic of China (April, 1986).

Wildlife consultant to U.S. Environmental Protection Agency.

Ecological consultant to the Boy Scouts of America (national level).

Paid reviewer of technical wildlife/conservation texts for: Holt, Rinehart, and Winston; Macmillan; and the Iowa State University Press.

Reviewer of technical manuscripts for The Journal of Wildlife Management.

PROFESSIONAL SERVICE AND ACTIVITIES (Continued)

Member of Agricultural Chemical Technology Review Board Advisory Committee for the state of Iowa.

Invited participant and leader in national and regional symposia and scientific workshops.

SPECIAL CERTIFICATIONS

Certified by The Wildlife Society as having fulfilled all of the requirements for qualification as a professional wildlife biologist.

Certified by the U.S. Fish and Wildlife Service as a biologist qualified to conduct or supervise field searches for black-footed ferrets.

Certified by the State of Wyoming as a biologist qualified to conduct surveys of threatened and endangered wildlife for the Wyoming Abandoned Mine Land program.

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

American Association for the Advancement of Science

American Institute of Biological Science

American Society for Range Management

East African Wildlife Society

Phi Kappa Phi - National Science Scholastic Honorary

Phi Sigma - National Biological Science Honorary

Sigma Xi - Scientific Research Society

The Wildlife Society

Xi Sigma Pi - National Forestry Honorary

UNIVERSITY COURSES TAUGHT

Principles of Wildlife Conservation

Wildlife Techniques

Wildlife Habitat Management (Graduate Level)

Wild Ungulate Management (Graduate Level)

Wildlife Population Ecology

UNIVERSITY COURSES TAUGHT (continued)

Animal Ecology

Basic Ecology

Principles of Game Biology

PROJECT EXPERIENCE - MINE PERMITS

Set up and carried out baseline wildlife studies and wrote materials required for state and/or federal permits to mine for:

1986-90	Malapai Resources Company's Christensen Ranch In-Situ Uranium Mine, Wyoming.
1985-86	Sunedco Energy Development Company's Soldier Canyon Coal Mine, Utah.
1982-83	Sunedco Energy Development Company's Sage Point-Dugout Canyon Coal Mine, Utah.
1982-83	Neil Butte Company's Keeline Coal Mine, Wyoming.
1981-82	Rancher's Energy Corporation's Echeta Coal Mine, Wyoming.
1980	Kerr-McGee Coal Corporation's East Gillette and Clovis Point Coal Mines, Wyoming.
1980	Kerr-McGee Coal Corporation's Jacobs Ranch Coal Mine, Wyoming.
1980	Central and South West Service's Ash Creek Coal Mine, Wyoming.
1980	Inberg Surveying - Gravel Mining Operation, WY
1979-81	Mobil Coal Producing Incorporated's Caballo Rojo Coal Mine, Wyoming.
1979-80	Exxon Mineral's West Highland Uranium Mine, Wyoming.
1979-80	Consolidation Coal Company's Pronghorn Coal Mine, Wyoming.
1979	United Nuclear Corporation's Morton Ranch Uranium Mine, Wyoming.
1979	Wyoming Mineral Corporation's Irigary Uranium Mine, Wyoming.
1979-79	Nerco Mining Company's Dave Johnson Coal Mine, Wyoming.

HAYDEN-WING, Larry D.

PROJECT EXPERIENCE - EAs AND EISs FOR OIL AND GAS DEVELOPMENTS

Field assessments and write-up of the wildlife sections for Environmental Assessments or Environmental Impact Statements on the following projects have been completed or are in progress:

In Progress	EXXON Carter Mountain Well Shoshone National Forest, Wy.	EIS/BE
In Progress	Wyoming Highway Department Snake River Canyon Project Bridger-Teton National Forest, WY	EIS/BE
In Progress	Wyoming Highway Department Farson-Fontenelle Fencing Project Green River BLM Resource Area, WY	EIS/BE
In Progress	Phillips Petroleum Company Ruby Well Custer National Forest, Montana	EIS/BE
August 1989	U.S. Forest Service Dubois Ranger District Pasture Creek Timber Sale Targhee National Forest	EA
August 1989	U.S. Forest Service Palisades Ranger District Spencer-Wolf Sheep and Goat Grazing Allotment Targhee National Forest	EA/BE
August 1988	AMOCO Production Company Nation Creek No. 1 Bridger-Teton National Forest, WY	EA/BE
March 1988	EXXON Carter Mountain Well Shoshone National Forest, Wy.	EA/BE
August 1987	AMOCO Production Company Sohare Creek No. 1-35 Bridger-Teton National Forest, Wy.	EA/EIS/BE

PROJECT EXPERIENCE - EAs AND EISs FOR OIL AND GAS DEVELOPMENTS (continued)

July 1987	Anschutz Corporation #10675-29, 6-19, and 0360 5-20 Wells Targhee National Forest, Idaho	EA
June 1987	Phillips Petroleum Company South Sand Dunes Field Development Platte River BLM Resource Area, Wy.	EA
May 1987	TRUE Oil Company Soda Unit Field Development Bridger-Teton National Forest, Wy.	EA
July 1986	EXXON Leidy Creek Unit 2 Well Bridger-Teton National Forest, Wy.	EA
Nov. 1985	Anschutz Corporation USA 8960 8-17 Well Bridger-Teton National Forest, Wy.	EA
Nov. 1985	Celeron Oil and Gas Company Beamers Bluff Fed. 41-24 Well Bridger-Teton National Forest, Wy.	EA
July 1985	Anadarko Production Company Whisky Springs Federal A-1 Well Wasatch-Cache National Forest, Wy.	EA
June 1985	SOHIO Ham's Fork 26B Well Bridger-Teton National Forest, Wy.	EA
June 1985	Marathon Thunderbolt Mountain Unit #1 Well Wasatch National Forest, Wy.	EA
May 1985	ARCO Kinny Ranch #1-4 Well Bighorn National Forest, Wy.	EA

HAYDEN-WING, Larry D.

PROJECT EXPERIENCE - SPECIALIZED WILDLIFE RESEARCH PROJECTS

Since 1979, the following projects have been set up and carried out:

Elk Calving Study (1985-86)

Objective: Assessment of oil drilling operations on elk calving activity.

Location: Bridger-Teton National Forest, Wyoming

Client: SOHIO Petroleum Company. Written report of 37 pp; Appendices, Maps.

Winter Elk Study (1984-85)

Objective: To determine distribution and movements of wintering elk on a proposed oil development area and assess potential impacts of development.

Location: Johnson County, Wyoming

Client: ARCO Oil and Gas Company. Written report of 56 pp; Appendices, Maps.

Occurrence of Migratory Birds of High-Federal Interest (1984)

Objective: To determine potential impacts of a proposed coal mine on migratory birds of high-federal interest.

Location: Carbon County, Utah

Client: Sunedco Energy Development Company. Written report of 14 pp; Appendices; Maps.

Winter Elk Study (1983-84)

Objective: To describe winter distribution and habitat affinities of an elk population on a proposed coal mine site and assess probable impacts of mining.

Location: Carbon County, Utah

Client: Sunedco Energy Development Company. Written report of 32 pp; Maps.

PROJECT EXPERIENCE - SPECIALIZED WILDLIFE RESEARCH PROJECTS (continued)

Sage Grouse Study (1982-83)

Objective: To determine movement patterns, level of loyalty to lek and nesting areas of radioed grouse using a booming ground on an active coal mine property.

Location: Campbell County, Wyoming

Client: Mobil Coal Producing, Inc. Written report of 84 pp; Appendices; Maps.

Winter Eagle Study #1 (1979-81)

Objective: To assess the potential impacts of open-pit coal mining on use of the mine permit area by wintering bald and golden eagles.

Location: Powder River Basin, Wyoming

Client: Mobil Coal Producing, Inc. Written report of 27 pp; Appendices; Maps.

Winter Eagle Study #2 (1979-81)

Objective: To compare winter food habits of sympatric populations of bald and golden eagles.

Location: Powder River Basin, Wyoming

Client: None, Independent Study by Hayden-Wing Associates. Scientific paper in progress.

PROJECT EXPERIENCE - OTHER FIELD SURVEYS AND IMPACT ANALYSES

In Progress — Technical advisor and analyst on wildlife issues for EXXON petroleum projects in southwestern Wyoming.

1986-87 — Performed annual wildlife monitoring surveys on four coal mines in south-central Wyoming for ARCH of Wyoming and wrote annual report for WDEQ.

1986-88 — Conducted field surveys for threatened and endangered wildlife on Abandoned Mine Land Projects 11, 12, 12B, 14, 15-3, 16-3, and 17 in Wyoming. Developed quantitative system for ranking waterfowl values of existing wetlands that are of maximum value to waterfowl. This new system and set of procedures was adopted by the Wyoming Game and Fish Department for evaluating the effectiveness of AML project mitigation programs throughout the state.

1986 — Conducted winter aerial surveys (two) of pronghorn and other wildlife on a 450-square mile area encompassing the following coal mines in the Powder River Basin in Wyoming: Antelope (NERCO), North Antelope and Rochelle (Powder River Coal Company), North Rochelle (Shell), Black Thunder (ARCO), and Jacob's Ranch (Kerr-McGee).

1985-87 — Advisor to American Cyanamid Company on research methodology and design for field testing impacts of certain chemicals on wildlife.

1985-86 — Expert witness and advisor to Baker County, Oregon on court case involving potential impacts of human activities and development on local elk populations.

1985 — Served as expert witness and advisor to Exxon Company, USA during Industrial Siting Hearings in Kemmerer, Wyoming on matters involving potential impacts of oil and gas development on elk population.

1980 — Wildlife habitat inventory and white-tailed deer utilization (pellet group index) on three units in the Custer National Forest, South Dakota, for the U.S.Forest Service.

1979 — Conducted field surveys and made assessments of potential impacts of Basin Electric Company's proposed Antelope Valley Transmission Line on threatened and endangered wildlife and wetland habitats in central South Dakota.

PROJECT EXPERIENCE - BLACK-FOOTED FERRET SEARCHING

Conducted prairie dog-ferret search projects every year from 1978 through 1987 on 13 mine sites, one power line right-of-way, one agricultural development area, three oil well development areas, and one private ranch. Projects included both black-tailed and white-tailed prairie dog colonies.

1987 Performed fall spotlight survey and burrow search for ferret sign on a 350-acre prairie dog colony in east central Wyoming for the Wyoming Resources Oil Company. The entire colony was mapped.

1987 Conducted three winter surveys for ferret signs on a 1,160-acre prairie dog colony in north central Wyoming for the BLM (Casper Office). The entire colony was mapped.

1986 Conducted three winter surveys for ferret signs on a 1,200 acre prairie dog colony in eastcentral Wyoming for the Reading and Bates Oil Company. Entire colony was mapped.

1982 Performed burrow search for ferret sign and spotlight search for ferrets on two prairie dog colonies on the Echeta Mine site of Rancher's Energy Corporation in northeastern Wyoming.

1980-81 Conducted aerial survey of Mobil's Caballo Rojo and Consolidation Coal Company's Pronghorn Mine sites in Campbell County, Wyoming for presence of prairie dog colonies. One 474 acre colony and mapped and burrow-checked and spotlighted during late August for two consecutive summers.

1980 Conducted aerial survey of Consolidation Coal Company's Emery Mine in central Utah for presence of prairie dog colonies. One colony was mapped and ground-checked for ferret sign.

1979 Conducted aerial survey of 340 miles of power line right-of-way in South Dakota for the Basin Electric Power Cooperative. Prairie dog and ground squirrel colonies were mapped and ground-checked for ferret sign.

1979 Mapped boundaries, inspected burrows for ferret sign, and spotlight searched for ferrets on 3 prairie dog colonies on Wyoming Mineral's Irigary Mine in northcentral Wyoming.

1979 Spotlight searched for ferrets on large prairie dog colony (about 400 acres) located on a private cattle ranch in southwestern Albany County, Wyoming.

1978 Mapped boundaries and surveyed 10 prairie dog colonies covering 774 acres in the Muddy Ridge area of central Wyoming for the Bureau of Reclamation. A total of 4,546 prairie dog burrows were inspected for ferret sign and spotlight searching for ferrets was performed.

PROJECT EXPERIENCE - BLACK-FOOTED FERRET SEARCHES (Continued)

1979-86 Routine aerial and ground searching for presence of prairie dog colonies was conducted on 8 mine sites in central and northeastern Wyoming (United Nuclear Corporation's Morton Ranch Mine, Exxon Mineral's West Highland Mine, Kerr-McGee's Clovis Point and East Gillette Federal Mines, Central and Southwest Service's Ash Creek Mine, Northern Energy Resources Company's Dave Johnson Mine, Neil Butte Company's Keeline Mine and Malapai Resource Company's Christensen Ranch Project; and 2 mine sites in Utah Sunedco's Sage Point-Dugout Canyon and Soldier Creek Mines).

HAYDEN-WING, Larry D.

PUBLICATIONS AND PRESENTATIONS

Hayden-Wing, L.D., S.A. Tessmann, B.R. Yates, and R.L. Sanders. 1989. Changes in wetland values on reclaimed abandoned mine lands in Wyoming. Pp. 445-463 IN: The evolution of abandoned mine land technologies: A symposium. Wyoming Dept. of Environ. Quality, Cheyenne.

Emerick, J., S.Q. Foster, L. Hayden-Wing, J. Hodgson, J.W. Monarch, A. Smith, O. Thorne, II, and J. Todd (Editors). 1988. Issues and technology in the management of impacted wildlife: Proceedings of a national symposium, Colorado Springs, Colorado Nov. 2-4, 1987. Thorne Ecological Institute, Boulder, Colorado. 177 pp.

Hayden-Wing, L.D., S.A. Tessmann, and R.G. Schreibeis. 1987. A wetland evaluation model for quantifying changes in wetland values on reclaimed abandoned mine land sites in Wyoming. Pp. 8-21 IN J. Emerick, S.Q. Foster, L. Hayden-Wing, J. Hodgson, J. W. Monarch, A. Smith, O. Thorne, II, and J. Todd (eds), Proceedings of a national symposium on issues and technology in the management of impacted western wildlife. Thorne Ecological Institute, Boulder, Colorado.

Bale, J.W., D.K. Boston, R.G. Schreibeis, L.Hayden-Wing, and K. Anselmi. 1987. Reclamation of abandoned mines and mitigation of impacts to wetlands. Pp. 136-143 IN K.M. Mutz and L.C. Lee (Tech. Coordinators), Proceedings of Eighth Annual Meeting of the Society of Wetland Scientists. Seattle, Washington.

Hayden-Wing, L. D., D. B. Costain, J. L. Hull, M. R. Jackson, and T. B. Segerstrom. 1985. Movement patterns and habitat affinities of a sage grouse population in northeastern Wyoming. Pp. 207-226 IN R.D. Comer, T.G. Baumann, P. Davis, J.W. Monarch, J. Todd, S. Van Gytenbeek, D. Wills, and J. Woodling (eds.), Proceedings of 2nd biennial symposium on issues and technology in the management of impacted western wildlife. Thorne Ecological Institute, Boulder, Colorado.

Hayden-Wing, L. D. 1984. Nongame species and mine land reclamation. Pp. HWA 1-15 In F. F. Munshower and S. E. Fisher, Jr. (Chairmen), Proceedings Third Biennial Symposium on Surface Coal Mine Reclamation on the Great Plains, Montana State University, Wyoming Game & Fish Dept., Bureau of Land Management, Office of Surface Mining, and Montana Dept. of State Lands, Billings, Mont.

Boyce, M. S. and L. D. Hayden-Wing (Editors). 1979. Proceedings of National Elk Symposium, Laramie, Wyoming. April 3-5, 1978. University of Wyoming. 294 p.

Hayden-Wing, L. D. 1979. Distribution of deer, elk, and moose on a winter range in southeastern Idaho. Pp. 122-131 In M. S. Boyce and L. D. Hayden-Wing (eds.), Proceedings of a National Elk Symposium, University of Wyoming, Laramie.

Hayden-Wing, L. D. 1979. Elk use of mountain meadows in the Idaho Primitive Area. Pp. 40-46 In M. S. Boyce and L. D. Hayden-Wing (eds.), Proceedings of National Elk Symposium, University of Wyoming, Laramie.

PUBLICATIONS AND PRESENTATIONS (Continued)

Konermann, A. D., L. D. Wing and J. J. Richard. 1978. Great blue heron nesting success in two Iowa reservoir ecosystems. Pp. 117-129 In A. Sprunt IV, J.C.Ogden, and S.Winkler(eds.) Wading Birds. National Audubon Society Res. Rept. No. 7.

Wing, L. D. and A. D. Konermann. 1977. Chlorinated hydrocarbon insecticide residues in the waters, fish, and great blue heron chicks of Rathbun and Red Rock Reservoirs. Abstract and data summary. Pp. 16, 114-116 In R. V. Bulkley (ed.), Proceedings of Pesticides in Iowa Surface Waters Workshop.

Wing, L. D. 1976. Honors adviser selection, training, and communication - a research report on the campus-wide survey of Iowa State University Honors Program. Pp. 29-37 In the Research Report Section of 1975-76 Annual Report on the ISU Honors Program.

Franson, J. C., P. A. Dahm, and L. D. Wing. 1975. A method of age determination in the mink (Mustela vison) by use of annual rings in mandible sections. Amer. Midl. Natur. 93(2): 507

Wing, L. D. 1975. Modification of pesticide technology to enhance wildlife survival. Invited presentation at the Eight-states Governor's Great Lakes Regional Interdisciplinary Pesticide Council, Madison, Wisconsin.

Agriculture Dean's Task Force on Environment (L. D. Wing, member and coauthor). 1975. Evaluation of proposed EPA guidelines on non-point source pollution. Iowa State University College of Agriculture. 52 p.

Franson, J. S., P. A. Dahm, and L. D. Wing. 1974. Chlorinated hydrocarbon insecticide residues in adipose, liver, and brain samples from Iowa mink. Bull. Environ. Contamination and Toxicology. 11(4): 379-385.

Agriculture Dean's Task Force on Environment (L. D. Wing, member and coauthor). 1973. Evaluation of proposed EPA guidelines on effluent regulation for the feedlot industry. Iowa State University College of Agriculture. 54 p.

Wing, L. D. 1973. Basic ecology manual. Copyrighted 1973. Iowa State University. 22 p.

Wing, L. D. 1972. Wildlife conservation manual. Copyrighted 1972 with annual revisions through 1977. Iowa State University (1972-1976), University of Wyoming (1977). 92 p.

Russell, K. and L. D. Wing. 1971. Scissor-tailed flycatcher sighting. Ringgold County, Iowa. Iowa Bird Life 41(1): 30.

Wing, L. D. and I. O. Buss. 1970. Elephants and forests. Wildl. Monographs No. 19. 92 p.

PUBLICATIONS AND PRESENTATIONS (Continued)

Wing, L. D. 1969. Ecology and herbivore use of five mountain meadows in the Idaho Primitive Area. Ph.D. Thesis, University of Idaho, Moscow. 215 p.

Buss, I. O. and L. D. Wing. 1966. Pre-impoundment observations of wintering mallards and nesting Canada geese on the Snake River, southeast Washington. Res. Studies 34(1): 1-36.

Wing, L. D. 1962. Big game and livestock browse utilization and feeding habits on a sandy range in southeastern Idaho. M.S. Thesis, University of Idaho, Moscow. 89 p.

ARCHIE F. REEVE
Director - Laramie Office

EDUCATION

1984	Ph.D., University of Wyoming, Laramie, Wyoming (Major - Wildlife Ecology; Minor - Statistics)
1970	M.A., Western Kentucky University, Bowling Green, Kentucky (Major - Secondary Education; Minor-Biology)
1968	A.B., University of Rochester, Rochester, New York (Major - Biology; Minors - Chemistry, Psychology)

QUALIFICATIONS SUMMARY

21 years experience as professional wildlife biologist, research scientist, teacher, manager, and administrator.

Experienced with a wide variety of wildlife species and habitats, including forest, range, and aquatic ecosystems.

Performed wildlife work in eight western states including Alaska.

Wildlife impact assessment experience on coal mine, oil well, transmission line, highway, ski area, and other developmental projects.

Experienced in the evaluation of impacts on Threatened and Endangered species, and other species classified as being of "High Interest" to state or federal agencies.

Expert witness experience.

Numerous technical reports, public presentations, and scientific publications.

AREAS OF SPECIALIZATION

Assessment of environmental impacts to wildlife.

Mitigation and avoidance of wildlife impacts.

Response of wildlife to environmental change.

Wildlife ecology and management.

Statistical analyses of wildlife data.

Hazardous waste impact assessment.

Pronghorn, mule deer, and lynx ecology and management.

REEVE, ARCHIE F.

PROFESSIONAL EXPERIENCE

1988 - Present	Director Laramie Office, Hayden-Wing Associates, Laramie, Wyoming.
1983 - 1988	Wildlife Research Scientist and Private Consultant, A. Reeve Consulting, Laramie, Wyoming.
1982 - 1983	Research Associate, Department of Zoology and Physiology, University of Wyoming, Laramie.
1979 - 1982	Research Associate, Wyoming Game and Fish Department/University of Wyoming on U.S. Bureau of Reclamation Project.
1978 - 1979	Biological Teaching Assistant, University of Wyoming, Laramie; Wildlife Research Consultant, Mine Reclamation Consultants, Laramie, Wyoming.
1977 - 1978	Wildlife Ecology Ph.D. student, University of Wyoming, Laramie.
1976 - 1977	Science Teacher, International Childrens Middle School, Los Angeles, California.
1971 - 1976	High School Science Teacher, Bureau of Indian Affairs, Kotzebue, Alaska.
1970 - 1971	Middle School Teacher, Bureau of Indian Affairs, Kipnuk, Alaska.
1968 -1970	Middle School Teacher, Adair County Public Schools, Columbia, Kentucky.

PROFESSIONAL SERVICE AND ACTIVITIES

Invited speaker: Wyoming Science Teachers Association, Wyoming Trappers Association, Wyoming Chapter of the Wildlife Society, and the Overthrust Wildlife Association.

Member of General Biology Search Committee and Seminar Committee, Department of Zoology and Physiology, University of Wyoming.

Freshman Orientation Advisor for Biological Sciences, University of Wyoming, Laramie.

REEVE, ARCHIE F.

SPECIAL CERTIFICATIONS

Certified by the U.S. Fish and Wildlife Service as a biologist qualified to conduct or supervise field searches for black-footed ferrets.

PROFESSIONAL SOCIETY MEMBERSHIP

The Wildlife Society
Colorado - Wyoming Academy of Science
Sigma Xi, The Scientific Research Society

AWARDS AND HONORS

1983 Colorado-Wyoming Academy of Science, James W. Broxon Research Award.

1981 Colorado-Wyoming Academy of Science, Excellent Student Paper Award.

1978 University of Wyoming, University Scholars.

PROJECT EXPERIENCE

1988 Research Scientist. Hayden-Wing Associates. Biological evaluations and environmental assessments for threatened and endangered species on proposed oil well drilling sites in Wyoming and Montana for Exxon U.S.A. and Phillips Petroleum.

1987-88 Principle Investigator. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming. Winter mortality of mule deer fawns in south central Wyoming.

1986-88 Principle Investigator. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming. Vehicle related mortality of mule deer in Nugget Canyon, Wyoming.

1986-87 Principle Investigator. Hayden-Wing Associates. Wildlife and raptor monitoring on Arch of Wyoming Hanna Basin Mines, Wyoming.

1987 Principal Investigator. Western Aquatics, Inc., Laramie, Wyoming. Potential effects of calcium from lake liming on human health.

REEVE, ARCHIE F.

PROJECT EXPERIENCE (cont.)

1987 Co-Investigator. Western Aquatics Inc., Laramie, Wyoming. Volume 5-Environment. State of Wyoming Site Proposal, Superconducting Super Collider.

1986 Principal Investigator. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming. Historical and recent distribution of lynx in Wyoming.

1985-86 Principal Investigator. J.R. Simplot Co., Pocatello, Idaho. Big game studies, Gay Mine Expansion Area, Fort Hall, Idaho.

1985-86 Field Supervisor. Mariah Associates, Inc., Laramie, Wyoming. Surveys for black-footed ferret occurrence in Wyoming, Colorado, and New Mexico.

1985 Consultant. Reviewing of Industrial Siting Permit Applications for the Wyoming Office of Industrial Siting Administration, Cheyenne, Wyoming.

1983 Consultant. Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming. Evaluation of coal development on mule deer.

1983 Co-Investigator. Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming. Hazardous waste production in Wyoming.

1982-83 Research Associate. Department of Zoology and Physiology, University of Wyoming, Laramie. Cooperative Wildlife Program, Phase I - Literature Review. Overthrust Industrial Association, Denver, Colorado.

1979-82 Principle Investigator. Wyoming Game and Fish Department, University of Wyoming, Laramie. Wildlife Studies - Medicine Bow Wind Energy Project. U.S. Bureau of Reclamation, Denver, Colorado.

1980-81 Evaluation of various wildlife projects for ARCO Coal Mines for Campbell County, Wyoming. Boyce Consulting, Laramie, Wyoming.

1978-79 Evaluation of wildlife sections for mining permits for major energy companies for Mine Reclamation Consultants Inc., Laramie, Wyoming.